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ABSTRACT

This course, one of 16 sequential courses comprising phase one of a part-time Bachelor of Arts degree program in Australian Studies, deals with the ways in which knowledge is historically classified into distinct fields. The example used is the 19th century demarcation between science and psuedo-science. The course is designed for independent study combined with tutorial sessions. Chapter 1 is an introduction to the course and its study objectives. Chapter 2, "Science: History of the Word," covers semantic history, professionalization, specialization, and disciplines. Chapter 3, "Defining Science and Pseudo-Science," discusses the attempts to sort the scientific from the nonscientific, using the examples of astrology, mesmerism, and phrenology. Chapter 4, "Disciplining Knowledge," deals with how knowledge is divided into disciplines and how these disciplines guard their boundaries. Chapter 5, "Modern Science and Pseudoscience," deals with changes in science in the 20th century and modern conflicts over what is scientific. Materials for the first tutorial session deal with the ways in which the scientific community is closed; the second is designed to help students with their essays. Also included are lists of required readings, additional readings, a bibliography, and self-assessment questions. (IS)

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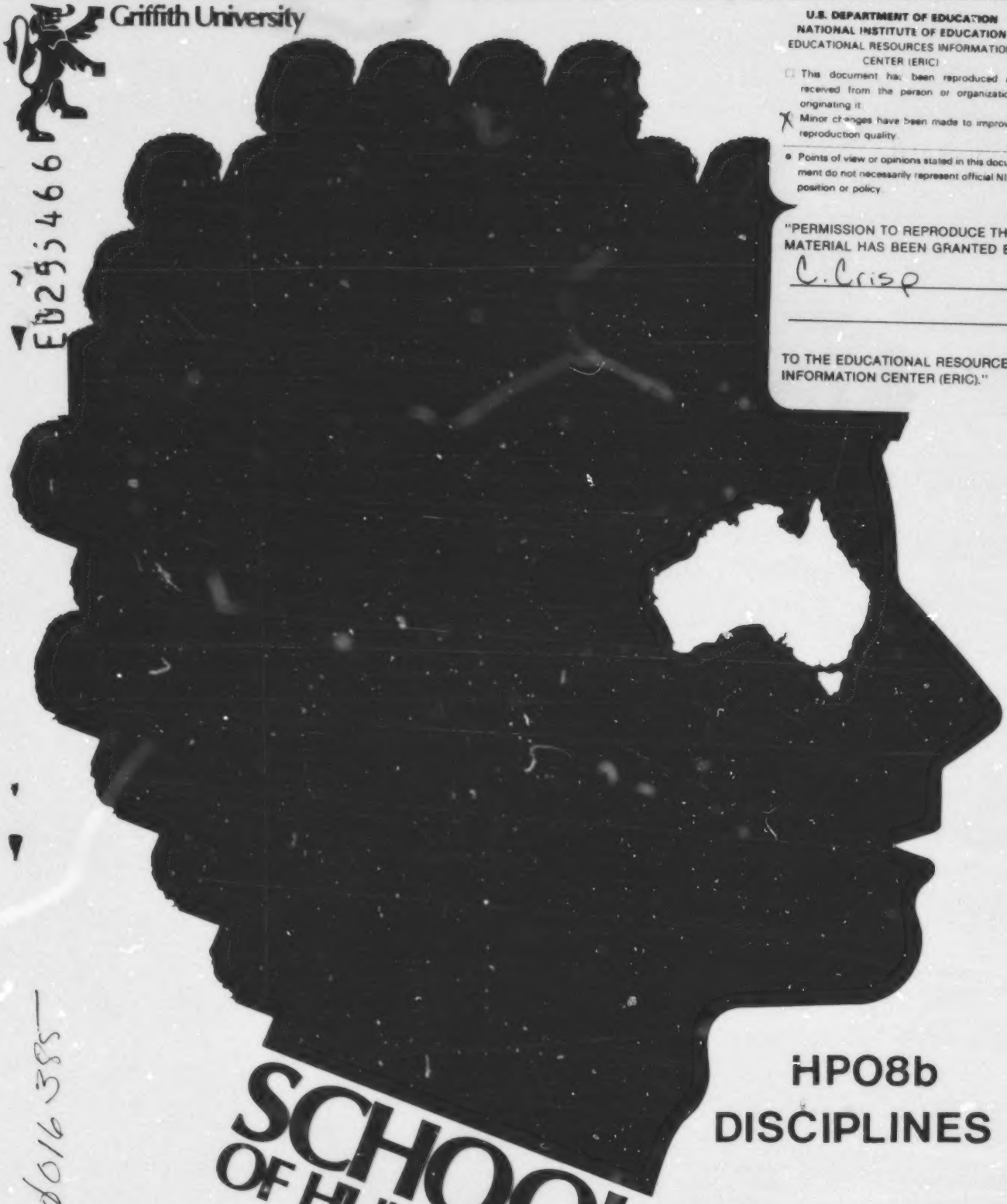

# SCHOOL OF HUMANITIES

## HPO8b DISCIPLINES

2

# PART TIME BA DEGREE

GRIFFITH UNIVERSITY
SCHOOL OF HUMANITIES

PART-TIME BA DEGREE PROGRAMME

# COURSE HP08b

# DISCIPLINES

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## COURSE INFORMATION: HP08b

### Course readings

No text book is required. The course uses readings taken from a variety of sources, details of which are given in the bibliography. A list of other sources referred to in the study guide and a list of suggested further reading are provided, but these materials are not necessary for successful completion of the assessment.

### Glossary

For your reference we have included at the back of this study guide a glossary of some of the terms you will encounter. Terms defined in the glossary are italicised in the text and marked with an asterisk.

### Tutorial activities

There are two tutorials for this course (pp.52 and 72) and, as in the previous courses, they will give you an opportunity to discuss any questions or difficulties you may have. Before each tutorial you should give some consideration to the relevant SAQs and make some brief notes for use in the tutorial discussion. Tutorial Two will also help you with the planning of your essay.

As there is a large amount of the course before Tutorial One and then only a small amount before Tutorial Two, the two tutorials will be scheduled in consecutive weeks. However, attendance at tutorials is not compulsory. If you cannot or do not wish to come you can still check your progress by consulting the answers to the SAQs at the end of the study guide and writing down a few notes to the tutorial discussion questions.

### Assessment item

The assessment in this course is by essay. The question requires you to apply the concepts developed throughout the course to a controversy known as the Velikovsky Affair - a clash between orthodox and unorthodox scientific theories. Readings 23-27 deal with this debate.

The essay has two parts: the first asks you to apply concepts from earlier sections to the Velikovsky Affair; the second part requires a comparison of this dispute with other disputes discussed in the course. The length of the essay should be 2000-2500 words.

## LIST OF READINGS

Readings are numbered in order of use, and aggregated according to the section of the study guide in which they first appear.

Section 2 (pink cover)

Reading 1. Raymond Williams, 'Art' (excerpt)

Reading 2. Fritz Machlup, 'Scientific knowledge' (excerpt)

Reading 3. Raymond Williams, 'Science' (excerpt)

Section 3 (cream cover)

Reading 4. Lynn Thorndike, 'Astrology and science'

Reading 5. Keith Thomas, 'Decline of astrology' (excerpt)

Reading 6. Thomas Sprat, 'Royal Society'

Reading 7. Everett Mendelsohn, 'Social construction of science' (excerpt)

Reading 8. Karl Popper, 'Problem of demarcation' (excerpt)

Reading 9. Mary Shelley, *Frankenstein* (excerpts)

Reading 10. Robert Darnton, 'Franz Mesmer'

Reading 11. Robert Weyant, 'Animal magnetism' (excerpts)

Reading 12. Terry Parssinen, 'Mesmerism and medicine' (excerpts)

Reading 13. Terry Parssinen, 'The phrenology movement' (excerpts)

Reading 14. David de Giustino, 'Phrenology and medicine' (excerpts)

Section 4 (yellow cover)

Reading 15. Jack Morrell and Arnold Thackray, 'The hierarchy of sciences' (excerpts)

Reading 16. Robert Merton, 'Science and democracy' (excerpts)

Reading 17. Bernard Barber, 'Scientific resistance' (excerpts)

Reading 18. Michael Polanyi, 'The republic of science' (excerpt)

Reading 19. Thomas Kuhn, 'Dogma and science' (excerpt)

Reading 20. Paul Feyerabend, 'The strange case of astrology' (excerpt)

Reading 21. Thomas Kuhn, 'The route to normal science' (excerpts)

Section 5 (blue cover)

Reading 22. A.J. Meadows, 'Specialisation and the amateur'

Reading 23. George Kolodiy, 'Paradigms in collision'

Reading 24. Lynn Rose, 'Interdisciplinary synthesis' (excerpts)

Reading 25. Lynn Rose, 'The domination of astronomy over other disciplines'

Reading 26. Norman Storer, 'The sociological context' (excerpts)

Reading 27. Dorothy Nelkin, 'Creationist science' (excerpt)

## PRELIMINARY EXERCISE

Classify these subjects as 'scientific' or 'non-scientific'.

| | |
|---|---|
| physics | history |
| sociology | anthropology |
| astrology | psychiatry |
| physiognomy | literary criticism |
| psychology | astronomy |
| alchemy | ecology |
| phrenology | mesmerism |
| archaeology | |

Which subjects did you find difficult to put in either category? On what criteria did you base your classification?

## 1 INTRODUCTION TO THE COURSE AND ITS OBJECTIVES

You have come across the topic of classification in some of the previous courses. In Course HP01a, *Defining Australia*, you looked at debates about the classification of people and images as 'Australian'. The next course discussed the ways in which certain aspects of the past are classified and maintained in traditions. Among several other courses which could be cited, HP04a, *Cultural Formations*, posed questions on what is to be classified as culture, and HP04b, *Literary Studies*, asked what writings are classified in the category of Australian Literature. In a more social scientific domain, Course HP05a, *Work in History*, asked what human actions are classifiable as work. In other words, the concern with the classification of objects, actions, people and behaviours (recall the practical examples of the Penal Colony systems of classification of types of conduct in Course HP07a, *Penal Colony 1*) is a widespread concern. For this precise reason, the course you have just completed, HP08a, *Classifications*, takes classifications as its central focus, with particular attention given to historical shifts in the classification of mental illness.

In the context of those references to classification, some of the following questions have occurred: Who are the classifiers? How are boundaries between categories maintained?

In these courses, the concern has been primarily with classification as a form of knowledge, and with questions on the social and political effects of classification.

This course focusses, however, upon the classification of knowledge, that is the dividing up of knowledge into subjects or disciplines, and into categories such as 'scientific', 'non-scientific' and 'pseudoscientific'. In proposing this focus, we are setting three general objectives:

1. to illustrate historical shifts in conceptions of science;

2. to consider the social and intellectual factors involved in the classification of knowledge as 'scientific' or 'pseudoscientific';

3. to examine the ways in which the boundaries between disciplines are formed and maintained.

### Maps of knowledge

Within the tradition, practice of classifying knowledge into categories such as contemplative versus practical, or abstract versus concrete, is at least as old as ancient Greece. Different thinkers in different historical periods have proposed different ways of classifying human knowledge.

We can give an example of this historical difference. At the beginning of the seventeenth century, Francis Bacon discerned three kinds of knowledge which corresponded to three mental faculties: History depended on memory, Philosophy derived from reason and Poetry arose from imagination. In this scheme, philosophy included the sciences of God, man and nature so that the subjects of theology and astronomy were classified in the same general category. This classification could be contrasted with that of the nineteenth-century French philosopher, Auguste Comte, who regarded theology as belonging to a primitive stage of the human mind and therefore excluded it, together with philosophy, from his category of the sciences. Comte arranged the sciences in a sequence of increasing complexity: astronomy, physics, chemistry, physiology and sociology.

It would be interesting and instructive to compare various systems of classification. Such an analysis would show us how different thinkers in different periods have charted the map of knowledge. The alternative ways of dividing and classifying the subjects, of organising intellectual territory, would indicate the different relationships which people have perceived between various kinds of knowledge. We would find that our modern categories are not universal or timeless. This is the case even with the important classification on which we are going to focus in this course: the classification of some knowledge as 'scientific' and other knowledge as non-scientific. Even here there is evidence of historical change and debate.

Recalling the Preliminary Exercise

Let's now return to the Preliminary Exercise. What is it meant to illustrate? At this early stage of the course it might look quite straightforward: of course, you might respond, physics is a science and literary criticism is a non-science! From what you have seen of *physiognomy** and *phrenology** in Course HP08a, *Classifications*, you might be quick to label these as pseudosciences.

But the point here is that when we classify these disciplines we inevitably do so on the basis of present conceptions of scientific knowledge. We all know what science is - physics, chemistry and astronomy are examples of it. These subjects have set the standard for the idea of scientific knowledge: it is something which is quantifiable and *empirical**; it includes experiments which are repeatable; and it can make predictions which are testable. In addition, it is supposed to be objective rather than subjective: the value judgements and biases of the scientist are not supposed to influence results. This is the 'common sense' view of science today; it is the image popularised by the scientific community and the media.

Subjects which fail to measure up to this image are

either classified as 'non-sciences' or, to introduce an intermediate category, 'pseudosciences'. The first category is not necessarily a negative one - the study of philosophy is not usually said to be hampered because it is not scientific; but there is certainly the assumption that scientific knowledge is more authoritative and perhaps prestigious than non-scientific knowledge.

The intermediate category of 'pseudoscience' does, however, carry a negative judgement. It is applied to subjects which claim to be scientific. These could be subjects which deal with physical or biological phenomena covered by an established science. Thus, *alchemy** would be seen as a pseudoscience in relation to chemistry; phrenology in relation to neurology; physiognomy in relation to psychology. Alternatively, they could be disciplines which claim to employ the methods of the *natural sciences** in other areas. The case of the 'social sciences' is the obvious one here. Disciplines such as sociology, psychology and archeology often claim to be scientific in this sense, a claim that is sometimes rejected by natural scientists. In other parts of this course, and in subsequent courses, you will see that there are political and institutional factors behind this aspiration to the title of science.

In a word, then, this course takes up the matter of classifying knowledge as scientific or otherwise in order to raise questions which pertain to the general topic of the classification of knowledge. Three such questions are accorded particular importance:

1. Have there been historical shifts in the classification of knowledge as scientific?

2. Do social (as well as intellectual) factors influence this classification?

3. How have the boundaries between scientific disciplines and other forms of knowledge been formed and maintained?

## 2 SCIENCE: HISTORY OF THE WORD

### 2.1 Semantic history

We can usefully begin by looking at shifts in the meaning and usage of the word 'science'. This provides an indication of the different ways in which knowledge has been classified in different historical periods, and in particular an indication of a shift in the relationship between 'science' and 'art'. Today it is common to contrast Science with Art: the former is understood as an objective study of the physical world; the latter as a representation of the world, but not necessarily a realistic representation. The modern meaning of the word 'art', as in 'fine art', includes the sense of a subjective impression of the world and is therefore contrasted with the objective account of nature and its properties that is termed 'science'.

The first reading is from Raymond Williams's book *Keywords*; it shows that the meanings for the terms 'art' and 'science', as we understand them today, are comparatively recent. As you read Williams's entry for 'art', look for the earlier relationship between 'science' and 'art'. Williams is concerned to show the shift in the meaning of art from skill, craft or technique, in general, to a specific kind of skill, namely, the fine arts of painting, sculpture, etc. The point of interest to us is the fact that subjects such as astronomy and chemistry, insofar as they were formerly more or less what they are now, were classified as arts. Astronomy, along with subjects such as logic, rhetoric and music was one of the liberal arts of the medieval university curriculum. However, as Williams shows, the meaning of the term 'art' has also shifted. The contrast between contemporary usages such as 'the art of public speaking', and 'art gallery' suggest the scope of this shift.

**********

Read Raymond Williams, 'Art' (excerpt), reading 1.

**********

If astronomy and other subjects dealing with the natural world were considered arts before the eighteenth century, what was a 'science'? The word certainly existed but it did not have the primary meaning it has today. It derived from the Latin term *scientia*, whose meaning was 'knowledge'. This meant that it could be used in a general sense to refer to any kind of knowledge. Thus, the liberal arts, which included music, were also called liberal sciences. But there was another sense, dating from the time of Aristotle, in which science meant systematic knowledge capable of being logically demonstrated. Thus, in Samuel Johnson's Dictionary of 1755 the following different meanings of 'science' are listed:

(a) knowledge;
(b) certainty grounded on demonstration;
(c) art attained by precepts, or built on principles;
(d) any art or species of knowledge;
(e) one of the seven liberal arts.

'Systematic and empirical knowledge'

On the first two definitions which were common in academic circles during the eighteenth century, subjects such as physics and chemistry, which involved observation of and experiment with the natural world, were not strictly sciences. That is, the knowledge they offered was not logically certain in the manner of geometry.

The first part of reading 2, by Fritz Machlup, makes this point, showing how this sense of science excluded empirical knowledge.

**********

Read Fritz Machlup, 'Scientific knowledge' (excerpt), reading 2.

**********

The subjects we now refer to as sciences were called 'natural philosophy', a term meant to distinguish them from subjects built on a logical system of axioms, such as geometry. It is in this sense, as Machlup's historical survey shows, that the seventeenth-century philosopher, Rene Descartes, defined science as based on self-evident principles, a feature he claimed for his own philosophical system. Chambers *Cyclopaedia* of 1738 included this definition, thereby excluding empirical subjects such as chemistry from the category of science.

However, by the early-nineteenth century, a broader meaning of science had emerged which emphasised theoretical knowledge in contrast with practical knowledge, but without the reference to logical demonstration and certainty. This definition included the modern empirical sciences, contrasting them with arts of practical utility, such as brewing or engineering. Nevertheless, this distinction was not a rigid one until the late-nineteenth century. One English encyclopaedia of 1819, having made this distinction between science as theoretical knowledge, and art as useful or practical skill, remarked that: 'the precise notion of an art, and science, and their just adequate distinction, do not seem to be yet well fixed'. Indeed, the two areas were treated together in encyclopaedias, most of which were subtitled 'dictionaries of arts and sciences'.

However, despite this ambiguity, the term 'science' was no longer restricted to purely logical or axiomatic subjects such as geometry. It now referred to all kinds of

systematic study which sought theoretical knowledge rather than practical knowledge based merely on skills which required only practice. It was in this sense that the phrases '*science sociale*' and 'social science' were used from the late-eighteenth century in France and Britain respectively, to describe systematic examination of the social sphere.

## 'Only natural science'

However, there was a further shift of meaning which had great significance. From the 1830s, and only in Britain, the term 'science' narrowed and specialised its reference to the empirical studies of the natural and physical world. In other European languages, the equivalent term for science (e.g. *Wissenschaft* in German) continued to include all systematic, organised knowledge; in English, the dominant sense of science came to mean knowledge of the physical world. The term 'scientist' was not coined until the 1830s and it was introduced to separate investigations of nature from other forms of knowledge. Its 'inventor', the historian and philosopher of science, William Whewell, explained that:

> We need very much a name to describe a cultivator of science in general. I should incline to call him a Scientist. Thus we might say, that as an Artist is a Musician, Painter, or Poet, a Scientist is a Mathematician, Physicist or Naturalist. (Whewell, 1967, p.113)

Although the term 'scientist' was not immediately accepted by the British scientific community - until the end of the nineteenth century, its members preferred titles such as natural philosopher, naturalist or man of science - the restriction of the term 'science' to physical science, which Whewell implied, was soon established. The ninth edition of the *Encyclopaedia Britannica* (1875-1889) no longer included a definition under the word 'science' but referred its readers to the entries on specific sciences such as chemistry, astronomy etc. That is, the older sense of science as systematic knowledge was anachronistic by the late-nineteenth century. Similarly, the word 'philosophy', which once included the study of nature (i.e., natural philosophy) was referred to as a term 'now limited almost exclusively to the mental sciences' *(Encyclopaedia Britannica*, 8th edition, Vol.17, p.543).

SAQ 1

Which of these subjects would have been classified as a science before the nineteenth century? - chemistry, astronomy, logic, theology, geology, geometry, botany. In one sentence, indicate why this would have been so.

There was some opposition to this reorientation. For example, the cultural critic, John Ruskin, (mentioned in the naming and classification of knowledges in Course HP04a, *Cultural Formations*, section 4.2), protested against this increasing prestige of the physical sciences.

> It has become the permitted fashion among modern mathematicians, chemists, and apothecaries, to call themselves 'scientific men', as opposed to theologians, poets, and artists. They know their sphere to be a separate one; but their ridiculous notion of its being a peculiarly scientific one ought not to be allowed in our Universities. There is a science of Morals, a science of History, a science of Grammar, a science of Music, and a science of Painting; and all these are quite beyond comparison higher fields for human intellect, and require accuracies of intenser observation, than either chemistry, electricity, or geology. (Ruskin in Cook and Wedderburn, 1906, p.396)

At this point you could usefully review reading 2 and study the next reading by Williams. You should try to grasp the shifts in meaning which Machlup and Williams detect. Remember that these shifts did not take place in a clear-cut fashion which can be precisely dated. As the entry in the encyclopaedia of 1819 noted, different meanings co-existed. But the major long-term change was towards a specialisation of meaning: that is, science came to have the predominant meaning of physical science. Of course, this monopoly had to be defended against the claims of other subjects, such as the new social disciplines which aspired to the methods, concepts and prestige of the physical sciences. As for the situation that we confront today, the term 'science' is still liable to form new attachments, as a glance at the following selection of subjects in American graduate schools indicates: Meat and Animal Science, Administrative Sciences, Speech Sciences, Library Science, Mortuary Science. In other words, the term science continues to be extrapolated beyond the study of the natural world.

**********

Read Raymond Williams, 'Science' (excerpt), reading 3.

**********

The chart below attempts to put Williams's keywords in rough display form.

Schema of historical changes

Science/Scientia - knowledge; mainly abstract, logically demonstrated truths such as those of geometry; but also theology.

Science/Art - subjects such as chemistry seen as arts i.e., skills or techniques: e.g. brewing.

Science as systematic knowledge of any subject, including empirical subjects:

- theoretical rather than practical knowledge; therefore, Science versus Art (i.e., technology)
- natural philosophy as part of philosophical (i.e., systematic) knowledge
- social science.

Science as natural/physical science:

- restriction to subjects such as astronomy, chemistry, biology
- exclusion of psychological and social subjects.

SAQ 2

Give at least three examples of the various changes in meaning of the terms 'science' and 'scientific' listed by Williams.

Significance of this semantic history

These shifts in the meaning of the word 'science' are more than mere historical curiosities. In one sense, Machlup (reading 2) is correct when he says that the use of the term 'science' to describe theology or logic but not astronomy or chemistry 'was nothing but a terminological convention' (R2:2). But if taken too strictly this statement can obscure the important cultural issues behind such usage. The changing references of the term 'science' are connected with

the changing status of different kinds of knowledge. The consequences of these changes are, of course, far-reaching. The significant development from the seventeenth century has been the growing prestige of the natural sciences and the way they have come to assume a monopoly on the term science. The exclusion of other subjects from this title reflects the modern view of natural science as the highest form of knowledge, a status once held by theology.

## 2.2 Professionalisation

This growth in the prestige of the natural sciences introduced a further dimension to the classification of knowledge. With the emergence of scientific institutions in the seventeenth century (e.g. Académie Française and the Royal Society), and with the professionalisation of men of science during the nineteenth century, the nature of the boundaries between science and other forms of knowledge became a significant social and institutional issue. This had not been an urgent question in earlier times when the study of natural science, as natural philosophy, was regarded as part of a good general education. However, with the rise of a self-conscious class of 'scientists' in the nineteenth century, the boundaries of natural science became a matter of professional concern. Those who wanted to advance science as a full-time career were eager to stress its separate identity, the complexities of its subject matter and the need for specialist training. Concerned also with attracting research funds, they were careful about the kinds of inquiry to be included in properly professional scientific institutions.

These developments gave practical and political significance to the classification of knowledge as 'scientific'. In the following sections of this course we will investigate the ways in which the shifting boundaries between natural science and other kinds of knowledge have been formed and maintained. Our major focus will be on the demarcation disputes which have occurred when a theory or subject has been rejected as 'pseudoscientific' by sections of the scientific community. Our interest here will be in the factors, both intellectual and social, which have operated in these disputes in different historical situations.

## 2.3 Specialisation

Apart from the increasing importance of scientific knowledge as a category, the other major historical development of concern to this course is that of specialisation. Although, the division of knowledge into subjects (e.g. theology, astronomy, history) is an ancient one, the phenomenon of intense and often exclusive specialisation is recent. Before the mid-nineteenth century, it was still possible for writers or researchers in one subject to follow the debates

in another. There was communication across various subject-areas within physical science; and students of natural science did not isolate themselves from debates in subjects such as theology, history, political economy and literature. In this sense natural science was part of general culture.

In the discussion of work in Course HP05a, *Work in History*, you were introduced to the notion of the division of labour. This concept was articulated by Adam Smith, the Scottish political economist, in 1776, who argued that the division of tasks into several smaller tasks could increase the efficiency of manufacturers. Within about fifty years of Smith's writings, the principle of division of labour was apparent also in the sphere of intellectual work. This was most noticeable in the natural sciences. It became common for scientists to specialise in one subject and, by the end of the century, most fields of inquiry became inaccessible to those without the relevant, specialised training and expertise. This tendency soon spread from the natural sciences to other kinds of knowledge. Even History, a subject of general education, gradually adopted the specialised research focus of the sciences and became less open to the general reader.

## 2.4 Disciplines

This division of intellectual labour was associated with important social developments. Not only did research and learning become more specialised, but this process was reinforced by the growth of institutions, professional journals and educational programmes. This meant that knowledge was not merely organised into various subjects which might, in principle, be studied by anyone. Rather, knowledge became organised into disciplines which were not only defined by certain concepts and problems, but also were constituted by a particular community of professional experts with specialised training.

This distinction between subjects and disciplines is a useful way of underlining the two historical developments we have been discussing, namely, professionalisation and specialisation. As knowledge became divided into specialised disciplines which were the province of professional scientists, the question of classifying knowledge as scientific or otherwise became more urgent. As science became an institutionalised career, the issue of what counted as 'science' was no longer simply a debate about the merit or usefulness of the categories of an abstract system of classification, such as Bacon's. Instead, it was also a question which involved social status, and economic and political considerations.

## 2.5 Objectives of the following sections

The concept of disciplines as specialised and professionalised areas of knowledge is also important for an understanding of the disputes about the category of 'pseudoscience' which will occupy us in section 4. Such demarcation disputes arise when a doctrine or theory, proposed as 'scientific' by its supporters, is not recognised as such by the scientific community. But this confrontation is not always one between science in general and some isolated doctrine which has been labelled 'pseudoscientific'. Rather, it is more often a situation in which a particular scientific discipline attempts to ostracise a theory which impinges on its field and challenges its intellectual authority. In section 2, we will use case studies of two nineteenth-century pseudosciences - *mesmerism** and phrenology - to illustrate this perspective on scientific disciplines.

Section 4 will complement the historical material of section 3 with a discussion of theoretical work on the nature of the modern scientific community and the ways in which it maintains its boundaries. That is, it will look at accounts of how the scientific community deals with new knowledge, how it rejects ideas which don't fit prevailing conceptions of what scientific knowledge is. Again, the concept of disciplines will be important, and Thomas Kuhn's theory of how certain theoretical frameworks or *paradigms** constitute scientific discipline and determine what evidence they accept or reject, will be discussed. In general, the aim of section 4 is to discuss the role of authority and dogma in maintaining the boundaries of science and to emphasise the importance of particular specialised disciplines as the crucial points of conflict in demarcation disputes.

The final section of the course will bring the material of the previous sections to bear on a twentieth-century dispute involving the category of pseudoscience. With the help of the discussion in the previous parts of the course, you will be asked to analyse this dispute on the basis of the material provided in readings 23 to 27.

## 3 DEFINING SCIENCE AND PSEUDOSCIENCE

This section attempts to discuss the social and intellectual factors which have operated in the historical formation of the modern category of science. In doing so, it confronts the problem, introduced in section 2, of shifting conceptions and definitions of scientific knowledge. The contemporary, twentieth-century classification of knowledge into scientific and non-scientific cannot be taken as a natural classification. Our problem, then, is to recognise that modern ideas as to what counts as scientific cannot be read back into the past without careful qualifications.

### 3.1 Whig history

In two previous courses HP05a, *Work in History*, and HP08a, *Classifications* you have encountered the problem of writing the histories of the concept of work and theories of insanity. One of the difficulties confronting such histories is that of distancing ourselves from our present conceptions. There is often a tendency in such histories to see all past developments - for example, in psychological theories of madness - as gradual steps towards the achievement of the present, modern ideas. This has been called 'triumphalist' history because it sees a progress from a dark and ignorant past to an enlightened present. It is also called 'Whig' history because it follows the model of the nineteenth-century British historians who wrote as apologists of the 'Whig' party. In criticising this mode of writing the political history of England, Herbert Butterfield complained of the tendency in many historians:

> to write on the side of Protestants and Whigs, to praise revolutions provided they have been successful, to emphasise certain principles of progress in the past and to produce a story which is the ratification if not glorification of the present. (Butterfield, 1965, p.v.)

This mode of historical writing is called teleological (*teleology**). A teleological history is one which interprets the past as drawn towards some purpose or goal in the future. To take our previous examples, the past ideas of work or theories of madness would be seen as steps which lead to the present, better concepts. Such accounts interpret past phenomena or thought in terms of present assumptions to such an extent that they miss the important differences between concepts in different periods and their connection with specific and changing social contexts. The other crucial point about such teleological and Whig histories is that they operate with a principle of selection which is determined by present assumptions and preferences. In these histories, it is not usually all past ideas, say, on insanity, which are seen as gradual, progressive steps towards the present theories. Rather, there is a discrimination between those past ideas which appear to

contain glimmers of the present within them and those which are entirely superstitious, irrational and erroneous. From this perspective, the history of thought on a particular subject is written in terms of progressive and reactionary elements - the former being in tune with the proper movement towards the present ideas; the latter being temporary, but ultimately futile, reactionary forces.

Whig interpretations have been influential in the historiography of science. Modern scientific ideas have been taken as correct and past scientific thought has been judged in terms of its approximation to present theories. Men of science in the past have been praised if they seemed to move in the direction of a modern doctrine and condemned if they held to ideas which were later seen to be erroneous. This has led to a 'cult of precursors': that is, a search for thinkers in the past who are said to have anticipated the correct views of modern science on a particular topic. Past scientific ideas which don't fit this sequence of steps towards the truths of modern science are either criticised or disregarded.

This discussion of Whig historiography bears upon the topic of classification of knowledge. Whig historical accounts classify past ideas and theories in terms of their relationship with present thought. Thus, past scientific theories (and thinkers) are divided into those which approximated to modern views and those which did not. But with this approach, the criteria for what counts as scientific today are read back into the historical past. On this perspective, modern science and its empirical/experimental investigation of nature begins in seventeenth-century Europe with the work of Galileo, Kepler and Newton in the fields of astronomy and physics. Conversely, other seventeenth-century doctrines about the natural world such as alchemy and astrology, which are now regarded as unscientific or pseudoscientific, are placed in another category. In the Whig interpretation, they cannot be classified as part of science.

At this point, there are major problems concerning the history and classification of knowledge. Recent historical scholarship suggests that the boundaries between what is now recognised as natural science, and other forms of natural knowledge, were not clearly drawn in the seventeenth century. For example, astrology is now generally seen as unscientific or pseudoscientific (and you probably made such a response in the Preliminary Exercise). But during the seventeenth century its status in education circles was high and the distinctions between its doctrine and those which we would now call 'scientific' were neither clear nor rigid. One historian has remarked of astrology in this period that it was 'not a coterie doctrine but an essential aspect of the intellectual framework in which men were educated'. (Thomas, 1973, p.338.)

The subject had institutional recognition: there were Chairs of Astrology at the universities of Rome and Bologna.

Important astronomers such as Kepler, Tycho Brahe, Galileo and Newton all made astrological predictions at various times in their careers. Indeed, Newton spent more time working on alchemy (i.e., transformation of base metals into gold) and on biblical predictions about the last days of the world, than he did on his celebrated theory of gravitation.

It is tempting to rely on modern notions and to classify the work of those thinkers on astronomy and physics as the real science and their astrological, alchemical and mystical interests as irrational eccentricities. This is what Whig history of science does. The next reading is taken from the work of an author who was one of the first historians of science to attack historiography which allowed modern assumptions to dominate the interpretation of past ideas. Lynn Thorndike argues that, at least until the early-seventeenth century, astrology was a sophisticated intellectual system which incorporated the prevailing assumptions about the universe and employed elaborate mathematical procedures.

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Read Lynn Thorndike, 'Astrology and science', reading 4.

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SAQ 3

What is Thorndike's response to the view that the idea of general, universal natural laws began with Newton?

Having made these introductory remarks about the relationship between astrology and astronomy in the seventeenth century, it is important to clarify the general approach of this course. In Course HP08a, *Classifications*, you were introduced to the contrast between two approaches to the study of knowledge: (1) philosophical and epistemological (*epistemology**) and (2) sociological and historical. The first kind of approach focusses on questions such as the relationship between a theory (e.g. of classification) and the objective reality it claims to represent, or the methods and thought processes which have led to the theory. The second kind of approach is concerned with the institutional and historical contexts in which certain systems of knowledge occur and with their possible social and political functions.

This course adopts the second of these approaches to the study of different theories of natural knowledge. Thus, in the case of astrology and its relationship with astronomy in the seventeenth century, we are not concerned with judgements about the validity or truth of these doctrines as

accounts of the natural world. So, in questioning the Whig interpretation of astronomy as 'science' and astrology as 'pseudoscience', we are not suggesting that these two doctrines are (or were) equally valid forms of knowledge. Rather, we are interested in the way the relationship between these doctrines was conceived by contemporaries and with the social and intellectual factors which led to the decline of astrology as an acceptable form of knowledge.

## 3.2 The problem of demarcation

Throughout this section we will be dealing with the distinction between science and pseudoscience. Following from the previous discussion it will be useful, at this point, to consider one example of an attempt to draw an absolute and universally applicable philosophical or epistemological demarcation between these two categories. The most influential of these attempts is that of Sir Karl Popper, the philosopher of science. Popper distinguished between the origin (the context of discovery) and the proof (the context of justification) of ideas. He was happy to admit that scientific theories could come from anywhere: e.g. dreams, intuitions, readings of ancient mythology etc. However, they could only be accepted as 'scientific' if they were open to empirical test: that is, if they were, in principle, falsifiable. If a theory did not give rise to hypotheses which could be tested and which could go against the theory, it had to be labelled 'pseudoscientific'. For Popper, the two major pseudosciences were Marxism and Freudian psychoanalysis. He believed these subjects had pretensions to scientific, objective knowledge which could not be sustained.

## 3.3 Astrology and science in the seventeenth century

Now that the approach of the course has been classified, we can return to our seventeenth-century example. In discussing Whig history we highlighted the problem of reading contemporary twentieth-century distinctions into seventeenth-century debates. The application of the modern classification of astrology as 'pseudoscientific' to this earlier period would be a gross case of historical anachronism. That is, if astronomy in this period is seen to qualify as 'scientific', the evidence does not justify a classification of astrology as 'pseudoscientific'. In its attempts to discern general natural laws, in its assumptions about the relationships between macrocosm and microcosm and in its use of mathematical methods of prediction, astrology was part of the same intellectual framework as astronomy. Contemporary thinkers of the early seventeenth century did not make the same intellectual classifications as later Whig historians of science.

One writer has recently summarised this point:

> It is impossible to find an adequate body of evidence for regarding astrology and science as conflicting intellectual systems. Up to the mid seventeenth century, the vast majority of men of science seem to have accepted the basic postulates of astrology however strongly critical they may have been of its practitioners. Many would probably have shared Bacon's view that the subject needed to be reformed, not abolished. (Wright, 1975, p.410)

However, it is also necessary to recognise that astrology did lose its status as a reputable subject. By the late-seventeenth century there had been a radical change in attitudes towards it within educated circles. A comprehensive explanation of this change is outside the aims of this course; indeed, as Keith Thomas has shown in his book on *Religion and the Decline of Magic*, the question is very complex. The excerpt from this book in reading 5 deals with one of the intellectual reasons for the decline of astrology: namely, the fact that some of its assumptions began to conflict with the new concepts in astronomy.

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Read Keith Thomas, 'Decline of astrology' (excerpt), reading 5.

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SAQ 4

What tensions developed between astrology and astronomy in the late-seventeenth century?

## The Royal Society and the idea of science

In addition to these intellectual problems, it can be suggested that there were significant social factors at work in the formation of the modern classification of astrology as a 'pseudoscience'. In short, there were political considerations associated with the foundation of the Royal Society in 1660 which produced negative attitudes towards astrology.

The birth of the Royal Society of London marked the institutionalisation of science in Britain; it was the first official society having the 'Improvement of Natural Knowledge' as its aim. Similar societies had been established some years earlier in Italy and France.

You should note that the word 'science' was not used in the description of the Royal Society. As your reading of

section 2 should suggest, its members called themselves 'philosophers' or 'natural philosophers' and their interest was natural knowledge, including the useful arts (or technology). But it is clear that the Society began to forge the modern idea of empirical and experimental natural science. It did this not only by laying the basis for the concepts and methods which came to predominate in science, but by carefully drawing boundaries between natural science and other forms of knowledge. Some recent historians of science have argued that the modern idea of science was a social and political, as well as an intellectual, construction; legitimate science was defined, in part, by what it excluded, and the grounds for this exclusion were often political.

The Royal Society was acutely concerned about its public image. Briefly, there were two reasons for this:

1. theological controversy surrounding astronomy since the conflict between Galileo and the Pope;

2. the philosophical and political connotations of magical and alchemical doctrines which were major parts of the contemporary study of nature.

The first of these was not so pressing, because it was possible to argue that enlightened Protestant nations, such as England, did not hinder the progress of man's study of God's world. In other words, the Galileo case was another instance of Vatican obscurantism. The second problem was more complex. It was difficult to divorce the study of nature from practices and traditions such as alchemy, astrology and magic, because these were major sources of natural knowledge. However, during the period of the Civil War (1642-1649) some of these ideas had become associated with political causes, such as republicanism. The Royal Society was founded in the period known as the Restoration - that is, the restoration of Charles II to the throne - and there was a strong aversion towards any ideas likely to revive the divisions of the Civil War.

The charter of the Royal Society therefore attempted to promote a politically neutral image of science; it tried to separate the study of nature from all controversial issues. In fact, science was presented as an area of consensus and fruitful co-operation for those who were divided on other issues. But in order to project the Society in this way, the meaning of science had to be carefully defined. In effect, this took the form of emphasising empirical studies of nature while excluding the philosophical, theological, ethical and political implications of scientific knowledge.

The next two readings relate, in different ways, to this process of demarcation. The first, reading 6, is from Thomas Sprat's *History of the Royal Society of London*, published in 1665 - that is, only five years after its foundation. You may wonder why a 'history' was written so

soon. The answer is that it was part of the Society's propaganda campaign. In this excerpt, Sprat is at pains to stress the serious, non-controversial character of scientific activity.

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Read Thomas Sprat, 'Royal Society', reading 6.

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SAQ 5

In stressing the empirical and factual nature of science, what kinds of inquiry and speculation does Sprat try to exclude?

Reading 7 is taken from a recent historical essay, which claims that the definition of what counted as science was strongly influenced by what was included in the activities of the Royal Society - the first major scientific institution in Britain. The author argues that subjects which had political, moral and theological implications were excluded. Thus subjects such as alchemy and astrology, although they were studied by some of the important men of science, were excluded because they were associated with particular sects, crafts or political programmes. The excerpt begins with a statement from Robert Hooke, an important chemist, who, like Sprat, excludes all controversial speculation from the activities of the Society. The author, Everett Mendelsohn, argues that the concept of science resulting from this demarcation was therefore influenced by political considerations.

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Read Everett Mendelsohn, 'Social construction of science' (excerpt), reading 7.

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## 3.4 The category of pseudoscience

The remainder of this section focusses on two nineteenth-century disputes about the classification of knowledge as 'pseudoscientific'. The discussion so far should alert you to the fact that these disputes are complex. We have seen that the question of what counts as scientific at a particular time involves sensitive historical judgements. We have also seen that the boundaries of scientific activity have been partly determined by social and political (as well as intellectual) factors. The classification of a doctrine

as 'pseudoscientific' marks an attempt to place it outside the boundaries of science. Disputes over this classification therefore reflect the complex factors which define these boundaries in particular historical situations.

The key questions which will recur throughout this section are:

1. Is there an absolute philosophical and methodological distinction between science and pseudoscience?

2. When has this distinction assumed importance?

3. Do social factors influence the classification of knowledge as pseudoscientific?

4. What do these demarcation disputes tell us about the nature of scientific disciplines?

The term 'pseudoscientific' was not employed until the nineteenth century. In fact, the emergence of the term 'pseudoscientific' coincides with the specialisation of meaning in the word 'science' from systematic knowledge to empirical knowledge of nature. As we have seen in section 2, this shift occurred during the nineteenth century. This was also the period in which natural science became a professionalised and institutionalised activity: that is, it could be pursued as a career and it became a recognised part of academic curricula. With these developments, together with the major advances in the fields of chemistry, electromagnetism, and their relationship with improved technology (e.g. steam, gas lighting, electric telegraph), science assumed major social and cultural importance. With wider education and literacy (see Course HP04a, *Cultural Formations*), scientific ideas also become more accessible to the public. The popular appeal of geology in the early-nineteenth century, and later the major impact of Darwin's evolutionary theory, reinforced the high public profile of science. In this context, there was a tendency for theories and doctrines of various kinds to claim scientific standing as a means of boosting their credibility. But because the scientific community was anxious to safeguard its recently won status, its leaders were vigilant in castigating unwelcome intruders. For both these reasons, the nineteenth century saw the first major flourishing of 'pseudosciences'.

## Pseudoscience and the hierarchy of sciences

But not all scientific disciplines enjoyed equal status. During this period, a hierarchy of sciences was established with the mathematically sophisticated subjects such as physical astronomy, physics and electromagnetism occupying the higher positions. Next came experimental subjects such as chemistry, then observational sciences such as geology, then taxonomic (*taxonomy**) subjects such as zoology and

botany. At the lowest rungs of the scientific hierarchy were the emerging human and social sciences: psychology, medicine, anthropology, sociology. In section 4 we will see how this classification and ordering of the sciences in terms of their mathematical, experimental and empirical dimensions become codified in the sections of the British Association for the Advancement of Science which was formed in 1831. It was the model for AAAS - the Australian Association for the Advancement of Science, established in 1887.

Both these associations covered a range of scientific disciplines, from physics to anthropology. They were arranged in sections which were labelled numerically or alphabetically. But this ordering of the sections was not a neutral one. Rather, the BAAS was dominated by mathematically inclined men of science who projected their system of classification on to the Association. The leaders of the BAAS determined the criteria (if not the terminology) of the present categories of 'hard' and 'soft' sciences. Hard sciences are those which can boast mathematically quantifiable laws, based on observation or experiment (e.g. physics, astronomy, chemistry); the soft sciences are those which have no laws from which predictions can be made, no repeatable experiments and which often depend on subjective interpretation (e.g. psychoanalysis, psychology, sociology, anthropology).

An awareness of this hierarchy of knowledge is important for an understanding of the disputes over pseudoscience. Most of these controversies occurred in subject areas or disciplines which occupied a low position in the hierarchy. Thus, the two most famous (or infamous) pseudosciences of the nineteenth century - phrenology and mesmerism - dealt with the phenomena of human and social behaviour. These areas of investigation had a low status in the British Association and, as we shall see, there were movements aimed at their exclusion.

The appearance and impact of phrenology and mesmerism relates, in part, to the lack of theoretical consensus in the fields of psychology and medicine. In this context, a variety of doctrines could flourish because it was difficult to show that they were less valid than the alternatives. In contrast, although there were heretical theories dealing with physics and astronomy (e.g. some anti-Newtonian doctrines based on Egyptian mythology), these made no impact because the relevant scientific disciplines were too secure and did not need to bother about recognising them as 'pseudoscientific'. Secondly, of course, the doctrines of mesmerism and phrenology, because they dealt with human behaviour, were able to attract popular attention outside the scientific community.

The previous comments should not be taken to suggest that disputes about pseudosciences always arise in the 'soft' disciplines of psychology, medicine and the social

sciences. Indeed, in section 5, we will study a twentieth-century controversy which involved some of the most quantitative disciplines: astronomy and physics. This is known as the Velikovsky Affair. Immanuel Velikovsky was the exponent of a controversial theory about the history of the solar system - including such catastrophic events as the near collision of Earth and Venus - which contradicted accepted scientific authorities. In Tutorial Two we will also look briefly at another recent debate involving the rejection of evolutionary biological theory by religious fundamentalists in America: the creationist scientists.

The next short reading is taken from one of Popper's major books, *Conjectures and Reputations* (1963).

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Read Karl Popper, 'Problem of demarcation' (excerpt), reading 8.

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SAQ 6

What, according to Popper, is the common failing of astrology, Marxism and psychoanalysis?

Lying behind Popper's philosophical demarcation problem, there is also a historical problem: namely, the shifts in what counts or what is recognised as scientific. Popper is searching for an absolute, philosophical distinction between science and pseudoscience which will apply to all historical periods. It may be possible to do this; but such a criterion would not confront the historical fact that certain doctrines now considered pseudoscientific were once seen as possessing the status of reliable knowledge.

Our concern in this course is with this historical complexity. We are not so much interested in whether astrology or phrenology or Velikovsky's theory are pseudoscientific in some definite philosophical or methodological sense. Rather, we are concerned with the social, political and intellectual factors involved in debates over the classification of doctrine as pseudoscientific in specific historical situations.

It might be interesting to gain another perspective on these themes from reading 9. If you have any queries following this reading you will have an opportunity to raise them in Tutorial One.

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Read Mary Shelley, *Frankenstein* (excerpts), reading 9, with the following questions in mind.

- What is the difference between the attitudes of M. Krempe and M. Waldman to the alchemy of Cornelius Agrippa and Paracelsus?
- Which of these, if either, could be described as Whiggish in his approach to the history of science? Why?
- What alternative view of the relation between alchemy and chemistry is present in the passage?

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## 3.5 Mesmerism and phrenology - nineteenth-century pseudosciences?

Before coming to modern demarcation disputes, it is useful to investigate two nineteenth-century pseudosciences: namely, mesmerism and phrenology. Today these two doctrines elicit the response of 'pseudoscience', 'quackery', 'nonsense' etc., almost spontaneously. For example, they appear in Martin Gardner's book, *Fads and Fallacies in the Name of Science* (1957). Its subtitle indicates Gardner's tone and position: 'The curious theories of modern pseudoscientists and the strange, amusing and alarming cults that surround them. A study in human gullibility'.

Gardner approaches the phenomenon of pseudoscience in a straightforward 'no nonsense' manner. Although some 'cranks' are brighter than others, and some doctrines less crazy than others, his account is largely in terms of a gullible, ignorant public and eccentric, 'paranoid' (p.12) pseudoscientists. He does not confront the social and historical questions of how and why certain doctrines are labelled pseudoscientific, and he does not appreciate the complexities of this process.

The following discussion attempts to show that the cases of mesmerism and phrenology, and their classification as 'pseudosciences', reveal complex debates about the meaning of science and the nature of scientific disciplines. It suggests, on the basis of these case studies, that there are problems confronting any unitary category of pseudoscience. These problems are:

1. historical shifts in classification of a specific doctrine (i.e., a *diachronic** problem);
2. the role of different disciplines in labelling a doctrine, or parts of a doctrine, as pseudoscientific in a particular historical context (i.e., a *synchronic** problem);

3. the influence of social, economic and political factors in classification.

## Mesmerism in late eighteenth-century France

Mesmerism was the name given to a theory about 'animal magnetism' associated with the work of Franz Anton Mesmer in the late-eighteenth century. After studying medicine in Vienna, Mesmer wrote a thesis in 1766 which suggested that there was an invisible force, akin to electricity or magnetism, which permeated the universe and affected human beings. A proper balance of this 'animal magnetism' was necessary for good health. From this proposition he became involved in treating various illnesses by the application of magnets. Pre-revolutionary Paris (i.e., before 1789) was thrown into a state of excitement by the effects (allegedly successful) of Mesmer's treatment. He soon found that these effects could be produced without magnets by simple manipulation.

The French government appointed a commission of the Academy of Sciences to investigate the phenomena. The committee concluded that Mesmer's theory of an invisible agent, a material force or fluid, was false, and attributed any effects to unknown psychological causes. The doctrine fell into disrepute in France and although, as we shall see, it was revived by some medical practitioners in England in the nineteenth century, it was invariably regarded as a fraud and its founder a charlatan. But under the name of hypnotism (from the Greek for 'sleep'), the therapeutic effects of Mesmer's semiconscious states were gradually given a recognised space in medical practice.

Reading 10 is the entry on Mesmer by Robert Darnton in the *Dictionary of Scientific Biography*.

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Read Robert Darnton; 'Franz Mesmer', reading 10.

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It is significant that this prestigious publication should include a two-page entry on Mesmer. In contrast, there is no space given to Velikovsky (coming up in section 5) whose theories arguably made an impact from the 1950s through to the 1970s equivalent to that made by Mesmer 150 years earlier. It is instructive to consider this comparison.

One can imagine a possible conversation amongst the editors of the *Dictionary of Scientific Biography*.

Scene: New York office of the General Editor, 197?

Prof Hardnose: What's this nonsense I hear about including an entry on Mesmer? This is a book about scientists and scientific theories, not about quacks and superstitions. Next thing you'll be telling me that we're having an entry on Velikovsky!

Dr Broadscience: You're taking a narrow perspective. Mesmer's theories were not entirely out of line with the science of his time; and, in any case, hypnotism, the phenomenon he discussed, has subsequently become an accepted part of medical theory. If we leave out Mesmer we may as well go back and delete the one on Freud!

Prof Hardnose: Precisely! I think we made a big mistake when we decided to include any of the human and social sciences. As I said before, we may as well now have one on Velikovsky, an ancient historian and psychoanalyst, who preaches crazy stories about stars and planets. We seem to be working with a definition of science which can't exclude anything or anyone.

Dr Broadscience: You're exaggerating - Velikovsky's theories have not received the scientific support which Mesmer's did.

General Editor: I don't think we should pursue this line of thought. Besides, Darnton has already submitted his piece, and it's very readable. The medical and social science people are also a large part of our audience, and they'll read it. By the way Dr B., do you know of anyone working on Velikovsky?

SAQ 7

How does Darnton see the status of Mesmer's theory in relation to scientific theories of the period?

Having read Darnton's short introduction to Mesmer you should be ready to try the more difficult analysis by Robert Weyant. One of the main points we want to take from this reading is the distinction been Mesmer's theory of animal magnetism and his therapeutic practice. This will allow us to see that there were two levels at which Mesmer's work was considered:

1. the physical scientists of the French Academy were looking at his theory of a force called 'animal magnetism';

2. the medical establishment, in France and later in Brita[illegible] were reacting to his practice of using subconscious trances as a means of therapy.

Thus, the question of mesmerism as a pseudoscience does not involve a single target or a single opponent: e.g. a unified scientific establishment.

## Reaction of physical scientists to mesmerism

The first three pages of the next article by Weyant aim to show that 'within the framework of the science of Mesmer's time, none of [his] propositions would be obviously non-scientific or nonsensical' (R11:2). Although Mesmer's ideas had some affinities with magical and astrological traditions (e.g. harmony of microcosm and macrocosm; influence of planets), his theory of animal magnetism was compatible with contemporary scientific concepts: e.g. electricity, mineral magnetism, gravitation. There were theories of these phenomena which involved reference to invisible fluids and ethereal particles similar to Mesmer's ideas. Weyant suggests that Mesmer had to explain the effects of his practice by reference to mechanical, material influence of a fluid or force (albeit invisible) in order to have it recognised by the scientific community.

So far, therefore, mesmerism was not pseudoscientific by the standards of contemporary science. Indeed, the fact that the French Academy agreed to test it suggests that it was not immediately rejected. On Popper's criterion (see reading 8), if a theory gives rise to testable proportions, it is not pseudoscientific, although it can be incorrect. The French scientists adopted the latter conclusion.

The next stage of the story (and argument) is crucial. In rejecting Mesmer's doctrine about the existence and activity of a magnetic fluid, the French Academy cast no doubts on the validity of the phenomena (i.e., human behaviour, curative effects) which he produced. They concluded that these were due to the 'imagination' (R11:3-4).

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Read Robert Weyant, 'Animal magnetism' (excerpts), reading 11.

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SAQ 8

1. Why does Weyant critise the categorisation of mesmerism as pseudoscientific?

2. Why did the French scientists concede 'imagination' as an explanation (R11:3-4)?

Reaction of the medical community to mesmerism

It is here that the response of orthodox medical practitioners is important. They were violently opposed to mesmerism even before it was tested. But the conclusion of the French Academy reinforced this antagonism, not simply because the idea of a magnetic fluid had been dismissed, but because the Academy allowed for the possible influence of imagination as a cause of the phenomena. The medical profession was committed to physical explanations of bodily illness. The suggestion that some non-physical (non-somatic), psychological factor, such as imagination, could produce therapeutic effects, was a threat to its position on at least two counts:

- It threatened its theoretical base. This was already very insecure: there was no strong 'scientific' theory behind medical practice, but the orthodox practitioners were anxious to associate medicine with the fundamental assumptions of the scientific philosophy: i.e., mechanical, material causes.

- It threatened its economic base. If practices such as mesmerism were sanctioned, a host of unqualified healers could undermine the profession's fragile monopoly on health care. Indeed, mesmerism had already appealed to the upper classes in France. Robert Darnton has published a very interesting book on this, *Mesmerism and the end of the Enlightenment in France*, which deals with the popular appeal and politicial uses of mesmerism on the eve of the French Revolution.

What we have been able to see so far is that the dispute about the status of mesmerism was not a simple matter of a single doctrine being ridiculed by a unitary scientific community. Mesmerism was both a theory, cast in the terms of contemporary scientific language, and a therapeutic practice. There were different responses to these two aspects by two different groups: physical scientists and medical practitioners.

The physical scientists accepted the language and the concepts (e.g. invisible fluids) of Mesmer's theory but rejected it after experimental test. They then invoked 'imagination'. This concept lay outside their disciplinary framework and they did not recognise it in a 'scientific' sense, but they were happy to invoke it in a common sense fashion. The medical practitioners, on the other hand, could not accept this because it impinged on their sphere of knowledge and practice.

This concern with the way in which different disciplines or subject areas recognise or reject various kinds of knowledge and evidence will be treated in section 4. In section 5 we shall see that it is central to the Velikovsky Affair.

## Mesmerism and the medical community in nineteenth-century Britain

Reading 12 deals with some of the issues already discussed: e.g. the theory versus practice of mesmerism. But it also introduces new material. Its focus is nineteenth-century Britain rather than eighteenth-century France, and it looks at the reaction to mesmerism by the English medical profession. While covering some of the ground of the previous reading, it adopts a more explicit sociological analysis. Parssinen argues that in addition to any theoretical conflict, the dispute needs to be seen in the context of the legitimation of the medical profession in England. This body was concerned about its social status and, for various reasons, mesmerism and its exponents violated the boundaries of professional 'respectability'.

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Read Terry Parssinen, 'Mesmerism and medicine' (excerpts), reading 12.

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SAQ 9

1. Why couldn't orthodox medicine afford to ignore mesmerism?

2. Why was hypnotism tolerated in the late-nineteenth century?

The second last section of the article is important because it shows how a particular treatment (mesmeric or hypnotic trance) underwent a change in status. Once totally disreputable, it came to occupy at first a tentative and eventually a secure position within medical practice. For this to happen, two sets of conditions had altered:

1. Hypnotism became separated from the theory of animal magnetism. See the British Medical Association report of 1891 (R12:7).

2. The medical profession had become legally and socially more established and its professional boundaries more secure.

Thus, what was a part of a pseudoscientific doctrine in the early-nineteenth century became accepted medical practice in the twentieth century. In a sense then, one aspect of mesmerism was re-classified and became acceptable as hypnosis. Both the original classification of pseudo-

science and the re-classification reflected intellectual and social factors.

## 3.6 Phrenology in nineteenth-century Britain

Phrenology, like mesmerism, was a late-eighteenth century doctrine which flourished in the nineteenth century. When described in a casual manner as the reading of personality, or character, through bumps on the head, it is an obvious candidate for the title pseudoscience. Clearly, this is its current status. However, we need to recognise that this classification is problematic. In 1860, for example, the *Encyclopaedia Britannica* remarked that 'its claims as an established science are still *sub judice*'. By investigating the dynamics of the debate over phrenology, we can again learn something about the way in which the intellectual frameworks of disciplines, together with social and institutional factors, influence the classification of knowledge.

A comparison of two entries in recent encyclopaedias hints at the debate which once raged over phrenology.

1. Phrenology - the name given to a pseudoscience now discredited...
   (*Colliers Encyclopedia*)

2. Phrenology - the science which teaches that there exists...
   (*Encyclopaedia Americana*)

This disparity in labelling may simply reflect different editorial tastes, but after studying some of the historical research on phrenology we will see that it also points to the nineteenth-century classification disputes.

By comparing various editions of the *Encyclopaedia Britannica* we can see a shift in the status of phrenology from a controversial subject on the borderland of science to a thoroughly unacceptable doctrine of character analysis akin to palmistry or the reading of tea-leaves.

The editions from the 4th (1801) through to the 11th (1910) carried large entries on phrenology written by prominent men of science. These articles did contain criticism, but the fact that they were included in a prestigious publication suggests that contemporaries did not view the subject as ridiculous. However, after the 11th edition the entry on phrenology disappeared and has never returned, not even in the abbreviated form in which it appears in the two other modern encyclopaedias cited above. How can this shift from relative prominence to complete absence be explained?

The name phrenology (from the Greek: mind + discourse) was coined in 1815 and applied to the system of psychology

formulated by Franz Joseph Gall, a Viennese physician and his colleague, Johann Spurzheim. It was popularised by various people in Britain and America during the nineteenth century, but chiefly by George Combe, an Edinburgh lawyer.

The system can be described in terms of four principles:

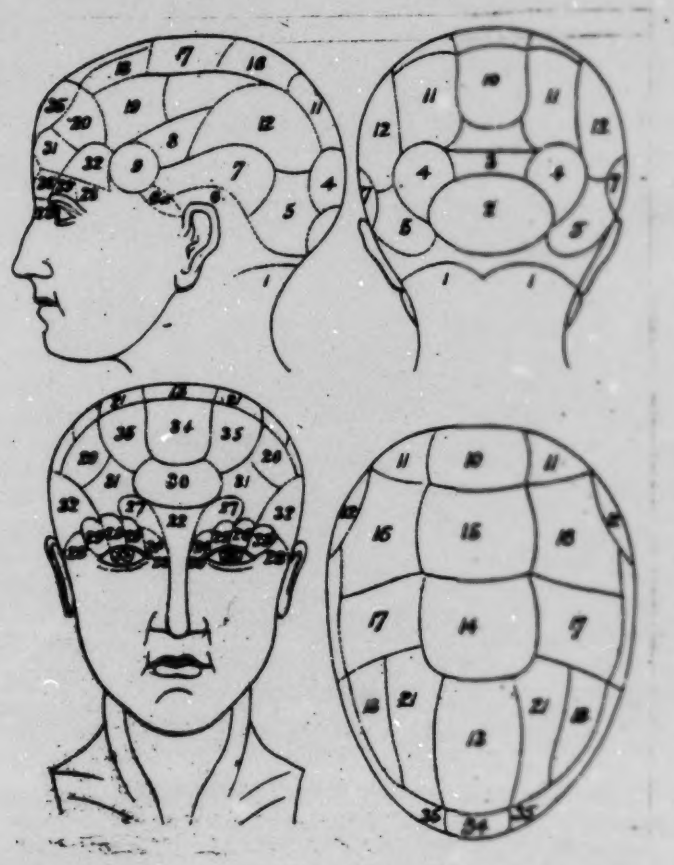
1. The brain is the organ of the mind.

2. The mental powers of man (*sic*) can be analysed into a definite number of independent faculties.

3. These faculties are innate, and each is located in a definite region of the brain.

4. The size of each of these regions is reflected in the contours of the skull and is a measure of the power of that mental faculty.

Thus, by 'reading' the shape of the head the phrenologist was assessing the strength of various mental faculties. The strength of these faculties was determined by the size of a corresponding mental organ in the brain. The following phrenological map of the skull is taken from the article on 'Phrenology' in the 9th edition of the *Encyclopaedia Britannica*.



In order to understand the debates over phrenology and the problem of classifying it as either science, non-science or pseudoscience it is necessary to recognise the manifold nature of its doctrine. You should remember that we engaged in a similar analysis in our study of mesmerism: we distinguished between the theory of animal magnetism and the therapeutic practice employing magnets, hypnotism etc. In the case of phrenology we need to make the following distinctions:

- its anatomical statements about the structure of the brain (i.e., its different regions) and its relation to the shape of the cranium or skull

- its physiological (the modern term would be neurological) theory about the functions of different regions or organs of the brain and their relationship to behaviour. That is, for example, the claim that higher intellectual processes were centred in the front of the brain; sexual behaviour at the base of the brain.

- its psychological system of thirty-five mental faculties which cause various kinds of behaviour. (Note: the exact number of faculties varied according to the version of the doctrine in question.)

- its philosophical commitment to a doctrine of scientific *naturalism*: i.e., the claim that all natural phenomena, including human thought and behaviour, could be explained by material causes and structures: that is, mental phenomena could be brought within the province of scientific, causal explanation.

- the social and political programme associated with phrenology: that is, a programme of educational and penal reform based on a naturalistic approach to human character and opposed to traditional systems of mental philosophy.

Given these various dimensions of the phrenological doctrine, it is not surprising that there were disputes about its status. Some aspects of the doctrine were considered to be 'scientific' contributions to the study of the brain or to the study of mind and behaviour. But the assessment of phrenology depended very much on the particular part of the doctrine in question and the discipline or profession of the assessor. It is necessary to distinguish four groups which made judgements about phrenology:

- social, political and scientific intellectuals

- mental philosophers

- general medical practitioners

- anatomists.

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These different groups are mentioned in reading 13. This is a general introduction to phrenology and the social movement connected with it in nineteenth-century Britain. The author, Terry Parssinen, is a social historian. We looked at his essay on mesmerism in reading 12.

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Read Terry Parssinen, 'The phrenology movement' (excerpts), reading 13.

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SAQ 10

List the objections levelled at phrenology by Parssinen in R13:3-5. Were all of these scientific objections?

The aim of the following discussion is to delineate supporters and opponents of phrenology, using reading 13 as our main source but supplementing it with other material.

## Phrenology versus mental philosophy

The first point to make about phrenology is that it enjoyed considerable support in early-Victorian Britain. Many important scientific intellectuals, such as Alfred Wallace and Herbert Spencer, were amongst its most vociferous exponents. Perhaps the major reason for this was its attempt to offer a naturalistic account of the mind: that is, to explain mental phenomena in material terms. It did this by arguing that the brain was the organ of the mind. As Parssinen indicates, the study of mind at this time was the province of mental philosophers and metaphysicians. The subject of psychology, as an empiricial scientific study of human behaviour, had not yet emerged.

So, in listing a reason for the support of phrenology amongst certain intellectuals, we immediately detect its major opponents. In suggesting that the mind could be dependent on the brain, and that it could be studied by an anatomical investigation of the brain, phrenology challenged the integrity of mental philosophy as a discipline.

The study of mental philosophy in Britain was central to the nation's philosophical tradition. Philosophers such as John Locke, George Berkeley and David Hume took as their initial problem the question of how the mind gained knowledge of the world. For this reason, mental philosophy was a significant subject and, especially in Scotland, it was an established discipline in universities. Thus, when Gall's doctrine was introduced in Edinburgh by Combe, the stage was set for a major conflict with academic philosophers such as Dugald Stewart and Sir William Hamilton.

As a rival study of the mind, phrenology clashed with mental philosophy in three fundamental ways:

1. It suggested that the mind was dependent on the brain; mental philosophy regarded the mind as an immaterial entity akin to the soul.

2. It claimed that there was a plurality of mental faculties; the mental philosophers saw the mind as an undifferentiated state of consciousness by which man achieved knowledge of the world.

3. It aimed to study the mind by empirical and comparative examination of brains; the method of mental philosophy was that of self-conscious introspection by the individual philosopher of his own mind. This was based on the assumption that the essential structure and activity of the mind was common to all men. The emphasis of phrenology was on individual differences.

## Conflicting social interests

Apart from these significant intellectual tensions there were social dimensions to the conflict between phrenology and mental philosophy. The phrenological attack on mental philosophy was also an attack upon the aristocratic values and social order associated with the universities and established bodies of learning. Phrenology presented itself as a progressive doctrine bringing the methods and concepts of the natural sciences to the study of man and society. It represented traditional teaching in this area as elitist and obscurantist. Besides appealing to intellectuals interested in an extension of naturalistic and materialistic kinds of explanation, phrenology offered a practical and accessible form of knowledge to a wide cross-section of lower middle-class society.

The social dimensions of attitudes to phrenology are suggested by the following chart which compares the memberships of the Phrenological Society and the Royal Society of Edinburgh. The Royal Society, unlike the Phrenological Society, was an established body of traditional learning; membership carried considerable social status. By comparing the character of the two memberships it is possible to make hypotheses about the extent to which support for phrenology differed from a general support for science and learning. The following chart is taken from an article by Steven Stapin in *Annals of Science* 32 (1975), p.229.

| Occupation | Phrenological Society (1826) | | Royal Society of Edinburgh (1820) | |
|---|---|---|---|---|
| | Number of members | Per cent | Number of members | Per cent |
| University of Edinburgh professors | 0 | 0 | 26 | 11 |
| Professors at other institutions | 0 | 0 | 18 | 7 |
| Gentry and aristocrats | 4 | 5 | 39 | 16 |
| Merchants, artisans, artists and engineers | 20 | 23 | 16 | 6 |
| Law | 27 | 31 | 40 | 17 |
| Medicine | 17 | 20 | 54 | 22 |
| Ministers | 6 | 7 | 17 | 7 |
| Military | 3 | 4 | 12 | 5 |
| Other/unknown | 9 | 10 | 22 | 9 |
| Total | 86 | 100 | 244 | 100 |

The following observations can be made.

- Academic and aristocratic membership of the Phrenological Society is negligible compared with that of the Royal Society.

- This contrasts with the fourth group which represents non-academic and new professional classes. These are the groups which were traditionally outside the Royal Society; Parssinen suggests that they were attracted to phrenology as the basis of a new reforming social philosophy.

The difference in social positions of the groups which supported and opposed phrenology is significant. By drawing its support from those outside the established academic institutions, phrenology became linked with groups whose social interests were often in conflict with the aristocratic social order. As cultural expressions of this order, traditional institutions such as the Royal Society were suspicious of phrenology.

Thus, members of the Royal Society, especially those most directly concerned, the mental philosophers and anatomists, had social reasons for rejecting phrenology. A critic writing in the *Edinburgh Review* of 1815 summarised this negative judgement:

> We must needs indulge ourselves with a summary paragraph too. The writings of Drs Gall and Spurzheim, have not added one fact to the stock of our knowledge, respecting either the structure or the functions of man; but consist of such a mixture of gross errors, extravagant absurdities, downright mistatements, and unmeaning quotations from Scripture, as can leave no doubt, we apprehend, in the minds of honest and intelligent men, as to the real ignorance, the real hypocrisy, and the real empiricism of the authors. (The doctrines of Gall and Spurzheim, 1815, p.268)

## Medicine and phrenology

Another significant set of figures is that which relates to the medical profession. The representation of this group, in percentage terms, is roughly the same for both societies. Of course, the actual numbers of medical men involved in each society is not equivalent, because the total membership of the Royal Society was much larger. However, this significant involvement of the medical profession with phrenology requires-comment. Why would medical practitioners be attracted to this doctrine? Reading 14, taken from a book on the phrenological movement in early-Victorian Britain by David de Giustino, offers some possible answers.

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Read David de Giustino, 'Phrenology and medicine' (excerpts), reading 14.

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SAQ 11

To which areas of medicine did phrenology offer possible guidance?

One of the major reasons for the medical interest in phrenology appears to be its naturalistic approach to both mind and body. This relates to some of the discussions in Course HP08a, *Classifications*. A significant number of general medical practitioners dealing with the area of mental illness believed that phrenology offered a convincing theoretical account of these disorders. They were particularly attracted by the way it explained such phenomena as departures from the normal state of the mental faculties due to some excessive stimulation or organic defect in the brain. Furthermore, by relating particular disorders to specific organs of the brain, phrenology reinforced the movement away from the eighteenth-century view of insanity as a general state of unreason.

It should not be inferred that this support for phrenology was uniform amongst the medical profession. It seems to have been clearer in the case of general practitioners who had to deal with common problems for which there was no adequate theory. However, in areas such as anatomy, where some aspects of the phrenological doctrine could be tested, the situation was quite different. Indeed, it was evidence from anatomy, an established university subject central to medical training, which provided the strongest refutation of phrenology.

## 3.7 The problem of defining pseudoscience: conclusions

As with the case of mesmerism, the discussion of phrenology indicates the problems confronted by an attempt to draw an absolute distinction between orthodox science and pseudoscience. Today, phrenology is classified as pseudoscience because it is rejected by the relevant, established disciplines such as neurology, neuro-anatomy and psychology. But when phrenology first appeared as a doctrine, these disciplines were not well developed. In this situation, many aspects of phrenology were not demonstrably outside the boundaries of scientific knowledge and this accounts for the reputable support it did receive.

As knowledge in these areas expanded, the details of the phrenological doctrine did not withstand testing. It is also true that some parts of it were simply not coherently formulated and thus not open to test. But it should be recognised that phrenology put several important questions on the scientific agenda which the new disciplines, such as neurology, began to follow. Thus, the general fact of a

relationship between different parts of the brain and various psychological and behavioural phenomena is one which came to be accepted, even though not in the precise form taught by phrenology. Similarly, the idea of individual psychological differences is still central to one field of psychology, in spite of the dismissive attitude of professional psychologists to phrenology.

So, again, there is a diachronic dimension to the problem of the classification of knowledge as pseudoscientific. In the case of phrenology, there was a shift from the status of a doctrine given serious consideration during the early-nineteenth century to that of a ridiculed pseudoscience in the twentieth century. However, as we have noted, some of the fundamental ideas of phrenology achieved scientific status in new disciplines which emerged as it declined.

The case of mesmerism contrasts, to some extent, with that of phrenology. It met with almost uniform opposition from contemporary scientific and medical circles but later the crucial phenomenon of hypnotism was accepted as part of psychiatry. That is, mesmerism was judged to be pseudoscientific in its own time, but a significant element of it was later reclassified. Both examples illustrate the problem of sustaining the notion of pseudoscience as an absolute category, as it cannot deal with the historical shifts in what has counted as scientific knowledge.

Both case studies also indicate that disputes involving the category of pseudoscience are not necessarily constituted by a clear conflict between a unified scientific community and a deviant doctrine. Instead, in these two examples, the conflict existed in relation to particular disciplines; in other words, the scientific disciplines most affected by the new doctrine reacted by labelling it as pseudoscientific. Medical practitioners opposed mesmerism because it appeared to threaten the physical theories of disease which they wanted to advance. Mental philosophers rejected phrenology because it proposed to translate the study of mind from a topic of metaphysics to one of anatomy and physiology. In both cases, social factors associated with the professional and institutional interests were also involved.

On the other hand, especially in the case of phrenology, there were some favourable responses from commentators in fields such as biology and medicine where the doctrine offered potentially useful concepts. Thus, even in a specific period there were different classifications of phrenology, or of various parts of its doctrine, by different disciplines.

A comparison of the reactions of the medical profession to mesmerism and phrenology is also constructive. From a twentieth-century perspective there is a tendency to unify these two doctrines under the category of pseudoscience in a

manner which does not allow for differentiation. But it is clear that contemporary nineteenth-century observers did make distinctions: the medical community rejected mesmerism but showed some interest in phrenology. Thus, doctrines which are now classified under the same category had different relationships to established disciplines of an earlier period.

## 4 DISCIPLINING KNOWLEDGE

The case studies of the previous section suggest that disputes about the category of pseudoscience cannot be adequately understood without reference to the disciplines involved, their intellectual assumptions and professional interests. This section will begin by showing how the organisation of knowledge into scientific disciplines is institutionalised. The discussion will draw upon material you have already encountered: the BAAS and the doctrine of phrenology.

The title of this section plays on the two meanings of the word 'discipline': that is, while knowledge is classified and organised into disciplines, these intellectual subjects also control or discipline the kind of evidence and knowledge which their practitioners accept. A large part of this section introduces work on this function of disciplines and its implications for the nature of the scientific community.

### 4.1 Knowledge and institutions

Now that we have studied two examples of classification disputes involving the category of pseudoscience we can show how such classifications can be institutionalised. The results of debates over the classification of doctrines can sometimes take concrete forms, for example,

- the non-registration of a doctrine as a legal health practice (scientology in Victoria);
- the exclusion of a subject from educational curricula (we will be dealing with such a case, the issue of creationist science, in Tutorial Two).

Can you think of any other examples?

One further case is that of the exclusion of subjects from academic associations and learned bodies such as the American Council of Humanities, the French Academy, the American Philosophical Society or the Australasian Association for the Advancement of Science. Inclusion of a subject in these institutions, either as a topic of discussion or, more clearly, as a permanent division or section, is a mark of academic recognition. Conversely, exclusion from such bodies can be a public means of ostracising a particular subject, by casting it out of the body of true sciences. Some writers have suggested that by treating heretics in this fashion communities consolidate their own identities (see Course HP03a, *Community and Identity*). Such a notion can be applied to the case of academic and scientific communities: by excluding certain doctrines from the set of recognised sciences, or by confining them to a marginal position, such communities can underline and reinforce the boundaries between orthodox and

unacceptable knowledge. In some cases, this can mean the practical elimination of a pseudoscience through lack of funding or access to laboratories and equipment. For example, research into Extra Sensory Perception (ESP) has been a borderline subject throughout the twentieth century. Most Psychology departments in universities would not countenance experimentation in this area. But by organising themselves into an effective lobby group, and by recruiting supporters from some fields of physics, the parapsychologists (as they are now called) managed to gain some institutional recognition. This has often come not from orthodox psychology, the nearest cognate discipline, but from private foundations and, recently, from the US military which was worried about Russian experiments in the subject. Imagine the implications of telepathy for intelligence gathering or international diplomacy!

Given the importance of institutional recognition, new disciplines or sub-disciplines usually attempt to gain entry to a suitable academic association. The example we take here follows from the study of nineteenth-century pseudoscience disputes. We will look briefly at the attempt by the supporters of phrenology to have their subject included in the British Association for the Advancement of Science (BAAS).

## The institutionalisation of a hierarchy of knowledge

We referred to this Association when introducing the idea of a hierarchy of knowledge or disciplines. As we said there, the notion of a hierarchy of scientific disciplines ranging from the 'hard', exact sciences of astronomy and physics to the 'soft', non-quantitative disciplines, such as anthropology, was established in the early years of the BAAS.

The phrenologists, who already had their own association and journal, sought entry to the BAAS in the 1830s. For various reasons, as you shall see in reading 15, the doctrine was not admitted. By looking at this episode we can learn something about the definition and image of science which the leaders of the BAAS were seeking to establish.

In section 1, we came across the suggestion that the idea of science should be seen as something which is 'socially constructed'. That is, what is recognised as science in various historical periods is not something based on universal, absolute criteria; instead, there are social and political factors which influence the institutional recognition of science.

The author of reading 7 (Mendelsohn) argued that the meaning of science, as defined by the Royal Society in the seventeenth century, was forged by the exclusion of certain subjects which had dangerous political overtones.

Furthermore, a particular ethos, one of ideological neutrality and political indifference, was adopted by the emerging scientific community.

A similar process of definition was at work in the early years of the BAAS. The representatives of the mathematical and exact sciences wanted to impose a certain definition of science which would have excluded subjects which lacked an experimental or quantifiable basis. Thus, subjects such as literature, music, philosophy and philology (the study of language) were never included, although natural science co-existed with those subjects in the literary and philosophical associations which emerged in provincial cities during the eighteenth century.

At stake in this process of exclusion was the shift in the meaning of science from systematic knowledge to the more specialised sense of physical knowledge. The BAAS was a battleground of this struggle over possession of the word 'science'. The fact that there were sections for medicine and statistics by the third meeting shows that there was indeed a battle to be fought. Proponents of the more restricted definition of science had not been able to exclude these subjects, but they vigorously resisted the inclusion of similar areas of inquiry. As you work through reading 15 try to discover what these 'unwelcome sciences' had in common. After all, the similarities between phrenology and social statistics are not immediately apparent, but they were both opposed by the dominant faction within the BAAS.

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Read Jack Morrell and Arnold Thackray, 'The hierarchy of sciences' (excerpts), reading 15.

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SAQ 12

1. Which groups resented the monopoly of the word 'science' by physical scientists?

2. Why was phrenology excluded from the BAAS?

3. Why was there an attempt to restrict social statistics to collections of facts?

This controversy within the BAAS is useful for two reasons:

1. It provides a concrete illustration of how hierarchies of disciplines are institutionalised.

2. It suggests political and ideological criteria for the exclusion of subjects which dealt with human behaviour and socio-economic issues. From this perspective, it is possible to see that phrenology, irrespective of its scientific validity, was unwelcome as a science because of its moral and political connotations.

We can therefore argue that the specialisation of the word 'science' from systematic knowledge to physical knowledge was more than a simple semantic shift. The example of the BAAS debate shows that this was associated, firstly, with an emerging hierarchy of specialised disciplines within science and, secondly, with the exclusion of certain kinds of inquiry.

To an extent, the classification of subjects as pseudoscientific or unscientific was based on criteria taken from the mathematical and experimental sciences. However, social and political factors were also at work: the whole area of 'human sciences' was thought to be dangerous because it involved moral and ideological issues. Thus, social statistics could easily slide from collections of empirical data to value judgements about social policy, e.g. the Poor Laws. It was this movement into values and politics which the leaders of the BAAS wanted to avoid. The emphasis upon scientific knowledge as objective and politically neutral should be seen within this context.

## 4.2 Science: open or closed community?

A certain image of science emerges from the material presented in the previous discussion. It is one of the scientific community vigilantly monitoring the boundaries of what is accepted as scientific knowledge at a given time. Leaders of scientific institutions such as the Royal Society and the BAAS have been represented as maintaining a hierarchy among scientific disciplines and excluding serious forms of unacceptable knowledge.

In some disputes over the category of pseudoscience, criteria of proof or validity have not operated alone. Rather, the debates we have investigated have involved social factors such as the institutional interests of an established discipline (e.g. mental philosophy versus phrenology) or the economic interests of a profession (e.g. medicine versus mesmerism). Some subjects have been refused admission to scientific institutions because their political implications threatened the ethos of ideological neutrality which the scientific community began to cultivate in the late-seventeenth century. What has to be said here, of course, is that the adoption of this 'neutral' position was in itself a political act. The ethos of pure science, in the sense of being above politics and social problems, is an ideological position.

The image which thus emerges is one of science as a 'closed' community anxiously watching its boundaries for

possible intruders. Its reaction to novel ideas, new evidence and alternative theories would appear to be one of suspicion and resistance. Ironically, this is the image which nineteenth-century scientific campaigners such as T.H. Huxley ascribed to the opponents of science, especially the Church. Huxley presented a picture of the Church as a bastion of theological obscurantism, burning martyrs of science as heretics and allowing traditional authority to stand in the way of intellectual progress. He coined the term 'agnosticism' to epitomise the true spirit of science. The man of science (Huxley disliked the word 'scientist') was one who opposed all superstition and all dogma in defence of free inquiry. Open to all ideas and theories, he accepted nothing without first subjecting it to vigorous empirical testing. Writing in 1866 he said:

> The improver of natural knowledge absolutely refuses to acknowledge authority, as such. For him, scepticism is the highest of duties; blind faith the one unpardonable sin. And it cannot be otherwise, for every great advance in natural knowledge has involved the absolute rejection of authority...(Huxley, 1967, p.41)

It is this view of science as an 'open' community which became the dominant image and, indeed, the image promoted by scientists themselves. Karl Popper has been one of the major proponents of this view. In his book *The Open Society and its Enemies* (1945), he defended democracy against thinkers such as Plato, Hegel and Marx, claiming that their political theories advocate a society which would be closed to individual liberty of thought and action. Popper drew an analogy between science and democracy: both were founded on the belief in open debate and freedom of thought. This connection was reinforced by the hostility of fascist regimes to science before and during World War II.

This link between science and democracy became a central assumption in the influential sociological tradition associated with Robert Merton. In his work on the nature of the scientific community, Merton suggested that scientific activity and progress were best guaranteed by a democratic society. Although prepared to subject this proposition to historical inquiry, such a positive relationship seemed likely to Merton because of the compatibility between the norms and values of science and those of democratic societies. We will come to Merton's description of these norms in the next reading.

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Read Robert Merton, 'Science and democracy' (excerpts), reading 16.

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SAQ 13

1. How does Merton see the norms of science as the guarantors of an 'open' scientific community? Give examples.

2. What relationship does Merton see between the problem of pseudoscience and the exercise of authority?

Since the 1960s, a challenge to the idea of science as an 'open' intellectual endeavour has been elaborated by several writers, notably Michael Polanyi and Thomas Kuhn (you met them earlier in Course HP03a, *Community and Identity*, and Course HP01b, *Traditions*, respectively). The case studies of mesmerism and phrenology in section 3 suggested that the idea of an open scientific community might require qualification. In this section, we will look at accounts which argue that the role of dogma and authority is central to established science.

Polanyi and Kuhn suggest that the activity of classifying and drawing boundaries between different kinds of knowledge and evidence is not restricted to the confrontations between established science and pseudoscience. Rather, this process is characteristic of all scientific disciplines in their everyday response to problems, data and theories. On this view, disciplines (or sub-disciplines) within science draw quite rigid distinctions or boundaries between questions and data which are acceptable and those which are unacceptable as objects of study. This system of classification depends upon the kinds of problems which the discipline has successfully solved in the past. So, from this perspective, the knowledge produced and recognised by scientific disciplines is partly dependent on a form of tradition (reading 17). This understanding of the way disciplines work would also have implications for the conception of the scientific enterprise as an open, democratic community in which all ideas are freely entertained and equally tested. It would suggest that tradition, authority and dogma are central aspects of scientific disciplines.

The following set of readings will introduce you to these contrasting views of science: that is, the view of science as an open, democratic activity (Popper and Merton) and the analysis which points to the role of tradition and authority in science (Polanyi and Kuhn). While working through this material we can ask which, if either, of these views offers the best account of the classification disputes treated in section 3. We will also be able to carry these analyses of science into section 5, where we investigate a recent contemporary dispute about the boundaries of science.

## Doubts about the 'open community' of science

Reading 17 by Bernard Barber is a useful introduction to the kind of approach which qualifies the Mertonian view of science as an open community governed by the norms of universalism, communism, disinterestedness and organised scepticism. Barber suggests that resistance of scientists to new or different ideas is a common phenomenon in the history of science; he therefore suggests that Merton's norms are more usually broken than observed but central to the structure of normal scientific behaviour.

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Read Bernard Barber, 'Scientific resistance' (excerpts), reading 17.

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SAQ 14

1. Earlier in this section we referred to the idea of religious dogma versus scientific agnosticism (p.46). Why does Barber view this contrast as simplistic?

2. How does Barber employ the concepts of professionalisation and specialisation to explain the phenomenon of resistance in science?

Reading 18 is taken from an article by Polanyi called 'The Republic of Science'. You dealt with a part of this in Course HP03a, *Community and Identity*. Here our concern is with Polanyi's contribution to the debate about how the scientific community and its various disciplines deal with new knowledge. Merton and Popper suggest that all ideas, irrespective of origin, are (or should be) tested before being rejected. Barber's appeal to historical and sociological evidence leads him to see various kinds of resistance to novel ideas or approaches as a common aspect of scientific practice. Polanyi's analysis confirms this suggestion by revealing the importance of the exercise of authority in science.

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Read Michael Polanyi, 'The republic of science' (excerpt), reading 18.

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The metaphors Polanyi employs can cause some confusion. In referring to the 'republic of science' he is suggesting

that scientists should have freedom from any external control in their selection of problems and topics of investigation. For this reason, he opposed the British scientist and Marxist, J.D. Bernal, who urged that science should be directed by social needs. Polanyi believed that the progress of science depended on its autonomy in the search for abstract truths (many of which would turn out to have practical, social uses). But this emphasis on the autonomy of science, free from social control, was accompanied by a stress on the role of authority within the republic of science itself.

For Polanyi, science is a self-regulating system governed by the mutual criticism of its members. He recognised that this criticism could be exercised in a dogmatic fashion by those in positions of authority, but believed that this was necessary for the progress of science. Polanyi therefore makes both descriptive and normative comments on science. Like Barber, he offers a descriptive historical account of how science actually works; but like Merton, he also wants to make normative prescriptions as to how it should work. However, in contrast with Merton, Polanyi claims that science, in order to make effective progress, cannot be open to all ideas: established authority must act to select those hypotheses worthy of investigation.

SAQ 15

1. Describe the historical shift in the relationship between science and authority which Polanyi mentions?

2. Explain how authority in science, for Polanyi, is 'essentially traditional' (R18:2). Give an example.

Having worked through these last three readings, you have been exposed to the tension between the 'open' and 'closed' images of science. Merton (and Popper) believes that the world of science has relatively open boundaries; ideas and theories, provided they meet certain initial requirements (e.g. testability and falsifiability, for Popper) are not classified as pseudoscientific or unscientific without fair trial. All such ideas are treated with equal, but critical, scrutiny.

On the other hand, Barber and Polanyi argue that some ideas are resisted immediately and not tested. Drawing upon historical evidence, they cite cases in which hypotheses and theories have been rejected because they do not conform with existing theories or methods, or because they are proposed by someone marginal to the professional, scientific establishment. For them, the authority of the scientific community is often dogmatic; its scepticism is directed

towards new theories but not towards currently sanctioned doctrines. We next look at the position of Thomas Kuhn, who offers a more explicit theoretical account of why this is so.

## Kuhn on dogma and authority in science

Reading 19 is taken from Kuhn's 'The function of dogma in scientific research', published at the same time as his major book, *The Structure of Scientific Revolutions* (University of Chicago Press, 1970). A recent commentator has suggested that it 'has had a wider academic influence than any other single book of the last twenty years' (Gutting ed., 1980, p.v). Given the references to Kuhn and his ideas in a wide range of disciplines, this appraisal is by no means extreme.

We will not be attempting a detailed study of Kuhn. Our interest in his work is its relevance to the question of how scientific disciplines maintain their integrity by setting up intellectual boundaries between themselves and other forms of knowledge, both scientific and unscientific.

But before dealing with this aspect of his work, it is important to see how it relates to the previous readings. It is interesting to note that the papers by Barber, Polanyi and Kuhn were all published within a year of each other. Furthermore, they are all making a similar point: it is one of opposition to the view of science as 'open' to all data, hypotheses and theories. They are all indicating the role of authority and the influence of existing theories in science.

Kuhn's work follows on from Polanyi's in two ways:

1. He recognises the strong role of authority in influencing the reception of ideas; he sees this as making a positive contribution to the progress of science.

2. He extends Polanyi's analysis by giving a more specific account of what the authority of science defends: namely, the 'paradigms' of various scientific disciplines.

**********

Read Thomas Kuhn, 'Dogma and science' (excerpt), reading 19.

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The main theme of this reading may cause some confusion given that Kuhn's major book is about scientific revolutions. But there are two sides to Kuhn's analysis and our interest is in the conservative aspect of what he calls 'normal science'. It is because most scientific practice displays this conservative character that revolutions in science are

rare and often dramatic. It is only when a paradigm breaks down because it cannot resolve anomalies that a 'revolution' occurs and a rival paradigm takes over.

SAQ 16

1. How does Kuhn compare the role of textbooks in science with their role in the humanities?

2. In what sense does Kuhn see scientific education as dogmatic?

## TUTORIAL ONE

During the course (section 3.5) we have discussed two historical case studies of demarcation disputes involving the notion of pseudoscience. We noted the difficulties involved in a simple application of this term to any doctrines considered unscientific by twentieth-century standards. We also looked at the role scientific institutions play in classifying knowledge and enforcing boundaries between acceptable and unacceptable subjects. And, in the most recent readings, we have discussed the qualifications to the idea of science as a community, governed by norms which encourage an 'open' attitude to knowledge.

A review of SAQ answers would serve as a starting point but you should also come prepared to discuss the following questions:

1. How did social factors influence the classification of mesmerism and phrenology?

2. Why did the British Association try to exclude some social sciences?

The readings by Barber, Polanyi and Kuhn (i.e., readings 17-19) have raised questions about the role of authority, dogma, textbooks and paradigms in scientific thought. We may be able to focus our discussion of those concepts, and the interpretation of the scientific community they suggest, by using a short passage from a book by Paul Feyerabend (reading 20). His views on the philosophy of science are extremely controversial. While Polanyi and Kuhn have drawn attention to the dogmatic aspects of science, Feyerabend has gone further. Modern science, in his view, is like a religious institution, a church, which persecutes its heretics and adores its saints. He claims that, in many areas, modern science has triumphed over other forms of knowledge - witchcraft, magic, mythology - not by force of argument but by political power.

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Read Paul Feyerabend, 'The strange case of astrology' (excerpt), reading 20.

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1. Why does Feyerabend compare the 'Scientific Statement' unfavourably with the *Malleus Maleficarum* (hammer of evil), a theological condemnation of witchcraft?

2. Recall Kuhn's comment on science textbooks in reading 19. Now explain why Feyerabend says that the *Malleus Maleficarum* is superior to modern science textbooks.

3. What historical evidence does Feyerabend marshal to criticise the clear dichotomy between astrology and science which the 'Statement' asserts?

4. How does Feyerabend criticise modern astrology?

Come to the tutorial with some possible answers to these questions.

There will, of course, also be an opportunity to discuss any problems you have encountered in the course so far, and to raise any questions you may have in relation to reading 9, from Mary Shelley's *Frankenstein*.

## 4.3 Paradigms

Kuhn argues that scientific disciplines are constituted by 'paradigms'. These are models or 'exemplars' which determine what is to count as 'science' at a particular time and what is not. This is precisely the problem we have confronted in studying various disputes about the classification of knowledge. Kuhn's work is therefore important because it offers an account of how disputes about the recognition of knowledge occur within science, at the level of disciplines, as well as between established science and pseudoscience. It suggests that established scientific disciplines are maintained by a commitment to a particular paradigm which excludes various problems, theories and evidence.

Kuhn has been accused of being unclear about his concept of 'paradigm'. One critic (actually a supportive one) listed twenty-one different senses, or what she called 'multiple definitions', of a paradigm in his book. She narrowed these down to three:

1. paradigm as a general metaphysical position or world-view

2. paradigm as a set of tools or heuristic devices for defining and solving problems - it could be something tangible, such as a piece of apparatus

3. paradigm as a recognised example of scientific achievement which serves as a point of consensus for a section of the scientific community (e.g. a discipline or sub-discipline). (Masterman, 1970, pp.59-89)

In this course, we are not attempting to engage in complex debates over the concepts of paradigm. But the common denominator which emerges from these definitions is relevant. Kuhn is arguing that scientific disciplines are founded upon a commitment to a particular problem (or set of problems), often epitomised by the work of a major scientist.

Paradigms (e.g. classic achievements, sets of problems) are the things which give integrity and purpose to a discipline; they are the fundamental point of agreement and departure for the members of a group. Everyday or 'normal' science, for Kuhn, consists in striving to solve 'puzzles' which derive from the paradigm of the discipline. Kuhn is candid about the essentially conservative or, as Polanyi says, the essentially traditional nature of normal science:

> No part of the aim of normal science is to call forth new sorts of phenomena; indeed those that will not fit the box are often not seen at all. Nor do scientists normally aim to invent new theories, and they are often intolerant of those invented by others. Instead, normal scientific

> research is directed to the articulation of those phenomena and theories that the paradigm already supplies. (Kuhn, 1970, p.24)

From this perspective, the resistance of scientists to new discoveries, anomalies and different kinds of data is to be expected. Scientific disciplines usually recognise only the questions and kinds of evidence which conform to the prevailing paradigm. For Kuhn (and Polanyi), this is the way scientific progress occurs. Without this dogmatism, this reliance upon traditionally sanctioned doctrines, scientists would be swamped with a mass of randomly gathered data and a chaos of theories. In a sense, then, a paradigm provides shelter from alternative and possibly confusing views. Normal, everyday science consists in the gradual elaboration of theories within the framework of a single paradigm.

In his later work, Kuhn adopts the term 'disciplinary matrix' to refer to the way in which members of a discipline share a common way of classifying scientific data and problems. The student is initiated into this disciplinary matrix by working through sets of exercises in textbooks and then graduating into a 'research tradition'. Scientific disciplines therefore make progress by fixing on limited questions and by excluding other questions, hypotheses and evidence. The issue of boundary maintenance, discussed earlier in the context of clashes between established sciences and marginal or pseudosciences, is therefore also central to the activity of established scientific disciplines.

## 4.4 Review of relationships between sections 3 and 4

It is worth pausing here to give some idea of how we are going to use the ideas discussed so far.

As the last paragraph suggested, the concepts of disciplines, disciplinary matrix and disciplinary boundary are closely related to the problem of the classification of knowledge, the subject of section 3. There we took the case of scientific knowledge and investigated various disputes over the meaning of science and pseudoscience. We found that the debates over this issue have been complex, and certainly not reducible to a single factor.

Attempts to provide an absolute, philosophical criterion for the problem of demarcation (e.g. Popper's falsifiability) were seen to be difficult to sustain. This approach involved a universal category of 'pseudoscience' which failed to account for the historical shifts in the meaning of 'science' itself. If the word 'science' has had no constant meaning, then the category 'pseudoscience' cannot be constant or universal. Instead, it is historically relative, and debates about applying it in specific contexts can be seen as reflecting negotiations about the meaning of science.

In addition to this chronological (or diachronic) aspect to the problem of classification disputes, we saw that there was a synchronic dimension. The debates about the status of mesmerism and phrenology were characterised by varying responses from different disciplines. While neither of these doctrines received unqualified support, it was also clear that there was no consensus over their pseudoscientific character. Different disciplines, with different intellectual assumptions and concepts, reacted to specific parts of these doctrines in varying ways. We also saw that social, political and economic variables entered into the debate over the classification of these doctrines.

Having concluded section 2 at this point we began section 3 with a discussion of struggles between disciplines for places in the hierarchy of scientific knowledge. The BAAS was our example and we discussed the intellectual and social criteria which determined position in the hierarchy and those which operated to exclude certain subjects.

In our discussion of classification disputes, the terms 'scientific community' and 'discipline' have been employed. We spoke of the scientific community opposing and excluding certain doctrines and of scientific disciplines confronting each other in various ways. Readings 16-19 introduced us to theoretical work about the nature of the scientific community and its component disciplines. The debate involving Mercon, Barber, Polanyi and Kuhn on the nature of the scientific community (open versus closed) and its attitude to new theories allowed us to see the disputes about pseudoscience in wider perspective. That is, the problem of classification is central to one of the major debates about the image of science: should the scientific community give equal attention to all ideas, including those which appear incompatible with its established theories, or including those proposed by unqualified amateurs and laymen? Some of the approaches to this debate were normative, others descriptive. Our study lends support to the descriptive approach which used historical evidence to provide examples of resistance to new theories: the case of disputes involving the issue of pseudoscience shows how the problems of classification and boundary maintenance have been historically significant in defining the meaning of science.

## Relevance of Kuhn's work

This brings us back to the work of Kuhn, to a theoretical framework for the understanding of disciplines. In our discussion of demarcation disputes in section 3, we saw that the notion of a unified 'scientific community' was inappropriate. In the cases of mesmerism and phrenology, for example, the alleged pseudoscientific doctrine was not condemned by a single, coherent scientific establishment. Rather, there were varying responses from different subject areas and disciplines: e.g. physics or mental philosophy and anatomy. We also saw that a scientific institution such

as the BAAS was composed of disciplines which were often in a state of tension.

Kuhn offers a theory of the structure and dynamics of scientific disciplines which accounts, in part, for these historical phenomena. The paradigm of each discipline, according to Kuhn, determines what kind of data or hypothesis will be recognised. This means that the issue of boundaries between different kinds of knowledge exists within science at the level of disciplines as well as between estalished disciplines and marginal doctrines. For Kuhn, disciplines are intellectual frameworks preoccupied with boundary maintenance; their practitioners and students are, as it were, disciplined by training in a particular paradigm. One implication of this is that different disciplines may approach questions in different ways; there may not always be a single scientific answer, but rather an answer from physics and an answer from biology. In the late-nineteenth century, for example, physicists and geologists could not agree on the age of the earth. Arguing from different assumptions, and using different concepts, the physicists, such as Lord Kelvin, believed that geologists, such as Darwin, had grossly overestimated the antiquity of the planet. (The implication hanging on this was that Darwin's mechanism of natural selection had insufficient time in which to work.)

From this perspective, it is therefore possible to account for boundary disputes which do not simply involve a single scientific view against some deviant doctrine. It may therefore allow us to account for the synchronic dimension to the problem of demarcation: that is, the fact that mesmerism and phrenology were classified in different ways by different disciplines.

In the last few pages we have attempted a summary of the course so far. We have done this here - in midstride - in order to set up some of the questions which will provide the remaining data needed to attempt the essay topic. This assignment requires you to analyse a twentieth-century dispute, involving the categories of science and pseudoscience, employing the concepts and approaches used in the previous sections of the course. This will entail references to the historical case studies of section 3 and the theoretical debates of section 4.

For example, in the summary above, we made some references to the value of Kuhn's work for the understanding of the nineteenth-century disputes. Having worked through material on the Velikovsky Affair, you will be asked to assess its value in that particular case. It could well be that a theory about the nature of science - its disciplines, its controversies - may not apply equally to all historical periods. Since you will be asked to compare a twentieth-century demarcation dispute with the other historical case studies, we will conclude section 4 by considering some of the important changes in the character of science and its

social relations since the nineteenth century. In the first instance, this will take us back to Kuhn; in section 5 we will consider ways in which his theory may need to be supplemented if we are to grasp adequately the historical dimensions of controversies about the boundaries of science.

## The historical dimension in Kuhn

There is a historical dimension to Kuhn's analysis which is relevant to this course. In *The Structure of Scientific Revolutions* he stressed that the paradigms which characterise modern scientific disciplines did not always exist. He argued that the history of each scientific field revealed a series of successive paradigm shifts. In the theory of optics, for example, there was a shift from a paradigm set by Newton which viewed light as material particles or 'corpuscles' to one which regarded it as wave motions. The controversial feature of Kuhn's work is his stress on the discontinuous nature of these shifts, thus denying the view of science as a gradual accumulation of better and more truthful pictures of nature. As we saw in section 1, this latter view is presented in Whig histories of science.

But, in addition, Kuhn claimed that there were 'pre-paradigm' stages in the history of sciences, in which there were no clearly dominant paradigms. In these situations, competing approaches jostled with each other, data were collected in an almost random fashion and there were no definite problems capable of progressive puzzle-solving. In other words, the discipline had not yet 'got off the ground'.

Reading 21 provides some elaboration of this historical perspective. This excerpt is from chapter two of Kuhn's *The Structure of Scientific Revolutions*. Although the examples are from areas which are likely to be unfamiliar, the basic point is clearly made: that is, there are periods in the history of particular sciences in which no single paradigm provides a point of consensus. Although it is not stated in this excerpt, Kuhn believes that the social sciences such as psychology, sociology, anthropology, etc. are still in this 'pre-paradigm' stage. That is, they are fraught by disagreements over fundamentals; opposing theories have incompatible assumptions which don't allow them to share common concepts.

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Read Thomas Kuhn, 'The route to normal science' (excerpts), reading 21.

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SAQ 17

1. According to Kuhn, what forms of research occur in a science which does not possess a paradigm?

2. How and why does the form of scientific publication change when a paradigm becomes established?

There is a source of confusion - subsequently admitted - in Kuhn's use of the phrase 'pre-paradigm stage'. Kuhn overemphasised the extent to which early sciences were given to random collection of data (see R21:1). To represent previous scientific practices in this way is to fall into the error of failing to see anything but nonsense in pre-modern disciplines. In any case, such a portrayal is inconsistent with Kuhn's description of the pre-paradigm phase as one involving conflicting schools. The conflict here involves theories and assumptions, and in this sense it does involve paradigms. The pre-paradigm phase is thus marked not by the absence of paradigms but with unresolved warfare between two or more contending paradigms.

Having clarified this point, it is important to appreciate the significant historical changes associated with what Kuhn calls the development of 'mature' scientific disciplines. Since the early-nineteenth century, various fields of scientific research have developed into mature, normal sciences founded on definite paradigms. But together with these intellectual developments, there have been significant changes in the social relations of science. These will be discussed in the first part of the following section which will provide the basis for your essay.

# 5 MODERN SCIENCE AND PSEUDOSCIENCE

## 5.1 Specialisation and professionalisation: historical developments

In section 1 we mentioned the process of specialisation as one of the major historical developments in the organisation of knowledge. In the early-nineteenth century, science was crystallising into separate disciplines and, indeed, new disciplines were emerging. But compared with the twentieth-century situation, specialisation was not intense: men of science still moved across disciplines and could keep abreast of research in several areas. There were two important consequences of this situation:

- Wide, synthetic generalisations covering different areas of scientific knowledge were still thought to be possible and desirable.

- Scientific knowledge was not so specialised as to be inaccessible to those not fully engaged in scientific work, e.g. amateur enthusiasts.

The lack of intense specialisation is related to a second factor - the absence of professionalisation. In the first half of the nineteenth century, particularly in Britain, science was pursued by people whose financial support lay in other areas: for example, clergy, landowners, academics, industrial entrepreneurs. There was little formal training for scientists and only a minority were engaged in salaried scientific work.

This meant that scientific debate was open to a wide variety of participants. There was no rigid distinction between 'professionals' and 'amateurs'. It was only when science became a possible professional occupation that the term 'amateur' began to assume negative connotations. In order to legitimise themselves as a special class of intellectual workers, the professional scientists emphasised specialised training, formal accreditation (through universities) and publications. When these requirements were established, amateurs in science came to be regarded as superficial dabblers whose views did not warrant the notice of the scientific community.

Reading 22 is a brief but useful illustration of the above discussion. While reading it, watch for the key terms we have just used: specialisation, professional, amateur.

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Read A.J. Meadows, 'Specialisation and the amateur', reading 22.

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SAQ 18

1. What example does Meadows use to show that the participation of amateurs in science varies across disciplines?

2. How do changes in publication procedures reflect the growth of professional specialised science?

The combined effects of specialisation and professionalisation altered the nature of the scientific community and the character of the debates it conducted. In the early-nineteenth century the boundaries of the scientific community were not rigidly drawn: there was a range of scientific activity extending from that of a small number of full-time researchers to that of the casual, part-time collector or observer. Participation in science was open to anyone who wished to publish a book or submit a paper to a scientific society. There was no formal qualification barrier to this kind of participation. Consequently, scientific discussion was not restricted to small circles of experts: it was very much a part of public debate.

This had implications for the nature of scientific debate. Firstly, it was often conducted in general, non-specialist magazines which were read by the non-scientist. As Meadows notes, it was assumed that the general reading public was interested in sciences such as geology. Indeed, much of the debate on evolution before Darwin took place in periodicals which carried articles on politics, theology and literature.

Secondly, and deriving from this fact, discussion was not confined to the technical content of science (although this was treated) but included the broad cultural dimensions. In the case of the nineteenth-century debates, this meant that the theological and moral implications of scientific theories were seen as part of scientific debate: the scientists themselves sometimes used theological arguments in defence of their theories.

## Early nineteenth-century scientific community: the case of phrenology debates

Some of the significant features about the character of scientific discussion in the nineteenth century can be illustrated with reference to the case of phrenology. When we come to study twentieth-century demarcation disputes, it will be useful to return to this example for the comparisons and contrasts it reveals. In one part of the assignment on the Velikovsky Affair you will be asked to compare the conditions and factors operating in that dispute with the earlier demarcation controversies studied in the course.

The case of the phrenology debates (see sections 3.5 and 3.6 above) indicates the absence of a strongly institutionalised and professional scientific community in early nineteenth-century Britain. This meant that someone such as George Combe, a lawyer without scientific or medical training, could find a hearing and engage experts in debate. The distinction between trained medical men or academic mental philosophers and men such as Combe did not operate as a dichotomy between professional scientists and amateurs. There was a public forum for scientific debate through books, journals and lectures which could not be censored by the existing scientific institutions (e.g. Royal Society of Edinburgh, Royal College of Surgeons).

The point to be made here is that before the establishment of a professional scientific community, scientific theories could not be dismissed simply by reference to the qualifications of their supporters. Thus, in spite of the novelty of its claims and its challenge to established ideas about the mind, phrenology was subjected to scientific test and academic debate. It could therefore be argued that the early nineteenth-century scientific community was not 'closed' in the sense in which Barber, Polanyi and Kuhn describe the modern scientific community as a 'closed' one.

Another interesting feature of this debate is the way it involved different disciplines: biology, anatomy, mental philosophy and medicine. As suggested above, the nature of the doctrine of phrenology, dealing with the mind-body relationship, invited this interdisciplinary debate. However, it is important to note the relative lack of intellectual specialisation in the period which made this debate possible. For example, the claims of phrenology were debated with reference to the structure of the brain. This involved detailed measurements of the skull and dissections of the brain. Yet the two protagonists in these public demonstrations were Sir William Hamilton, a mental philosopher and George Combe, a lawyer. With the greater specialisation and professionalisation of scientific disciplines in the twentieth century, such a confrontation could not have occurred.

## Twentieth-century contrasts

By the twentieth century, a clear distinction between professionals and amateurs emerged and this was maintained by formal educational qualifications. There were preconditions for membership of scientific societies and, in practice, for the right to publish in recognised journals. In most scientific fields, the role of the amateur became extinct, although its demise was slower in areas such as botany and zoology than in chemistry and physics. The scientific community now consisted of <u>specialised</u> experts pursuing <u>professional</u> careers.

Accordingly, the broad public character of nineteenth-century scientific debate was displaced. Firstly, the structure of communication was transformed. The specialist journal rather than the book or general periodical became the standard mode of publication. And the detailed article or paper, drawing on a single discipline, was the standard form of scientific contribution.

Secondly, the content of debate narrowed. Most discussion took place between experts from the one discipline; interdisciplinary communication became less common. Correlated with this specialisation there was also an exclusion of non-technical issues from scientific debate. Whereas in the nineteenth century the social, moral and theological implications of a theory were discussed in close conjunction with its scientific claims, in this century these two aspects have become separated. Indeed, a mark of professional scientific discussion is its rigid exclusion of such issues, which have come to be seen as part of a popular, non-professional concern. Some critics have seen this as one reflection of the way in which intense specialisation and a narrow professional ethic have removed natural science from general social and cultural debate. Writing in 1952, Robert J. Oppenheimer, the so-called 'father of the atomic bomb', regretted this consequence of extreme specialisation:

> Today [as opposed to Plato's Greece], it is not only that our kings do not know mathematics, but our philosophers do not know mathematics and - to go a step further - our mathematicians do not know mathematics...We so refine what we think, we so change the meaning of words, we build up so distinctive a tradition, that scientific knowledge today is not an enrichment of the general culture. It is, on the contrary, the possession of countless highly specialized communities who love it, would like to share it, and who make some efforts to communicate it; but it is not part of the common human understanding...We have in common the simple ways in which we have learned to live and talk and work together. Out of this have grown the specialized disciplines like the fingers of the hand, united in origin but no longer in contact. (Quoted in Hagstrom, 1975, p.226)

## 5.2 Pseudoscience in the twentieth century

With this historical background, we can now look at controversies about the boundary between science and pseudoscience in the twentieth century. Two cases will be encountered:

1. the theories of Immanuel Velikovsky about the recent history of the solar system and his challenge to orthodox science, especially astronomy;

2. the clash between biblical fundamentalists and the evolutionary theory of established biology.

As noted earlier, your assessment essay will require an analysis of the first of these cases and a consideration of the second.

Why the problem of pseudoscience in the twentieth century? There is some point to this query because the strength of the modern scientific community suggests that it should not be worried by deviant doctrines. The question of 'pseudoscience' only becomes an issue if a group of scientists decide to label a certain doctrine pseudo-scientific, thus indicating that it falls outside the bounds of science, or outside those of a particular discipline. That is, they are saying that it is not simply a mistaken scientific theory, but that it is not a scientific theory at all. The charge of 'pseudoscience' is a means of ostracising a doctrine (and its exponents) from the scientific community.

But for this to occur, the established scientists have to feel threatened in some way. Why would the modern scientific community be troubled by examples of deviant knowledge? As we saw at the end of section 4, twentieth-century science is characterised by strong institutional controls. There is a formal process of accreditation leading to the position of professional scientist, and amateurs are excluded from scientific debate in a way which did not occur in the early-nineteenth century. Furthermore, the extent of specialisation is so great that most scientific knowledge is inaccessible to the layperson; even specialists from different scientific disciplines have problems of communication.

There do seem to be grounds, therefore, for asking why orthodox science should choose to notice ideas outside its boundaries, even if only to brand them as 'pseudoscience'. Why, for example, does the scientific establishment simply not ignore such 'pseudoscientific' doctrines?

The answer to this question lies partly in changing social attitudes to science since World War II, and especially since the 1960s. When scientific theory gave rise to the atomic bomb, science became political in a much more obvious way than in the nineteenth century. With the use of the atomic bomb as a military weapon, the neutral ethos of science was badly shattered. Science and its implications became a part of public political debate. During the 1960s this was followed by increasing concern about the effects of science and technology upon the environment. The 'counter culture' movement of this period, which searched for alternatives to the dominant values of Western society, made science one of its major targets. For some of the leaders of this movement, such as Theodore Roszak, the scientific attitude, with its *rationalism* and *materialism*, was central to the alleged problems of Western civilisation.

A proper study of this topic falls outside the province of the course. But it is important to recognise that there was a significant reaction against science in this period, particularly in the United States where science and technology were so dominant and successful. Apart from the criticisms of ecologists, there was a noticeable decline in enrolments for undergraduate science courses. By the early 1970s this phenomenon had been noticed in both the United States and Europe. Students were turning away from these previously prestigious disciplines and choosing courses in the humanities, social sciences and para-medical subjects. In some school curricula (including those in Australia) science began to lose its compulsory status.

In this same period - the 1960s and early 1970s - the popularity and volume of books, magazines and ideas which ran counter to orthodox science appeared to expand. One worried writer noted that the average bookshop sold more material on astrology and witchcraft than it did on science. The appeal of Eastern religions, such as Zen Buddhism, although not strictly equatable with the attraction of horoscopes in newspapers, all combined to provoke fears of a widespread 'anti-science' movement. The Australian philosopher, John Passmore, felt sufficiently concerned about this movement to write a book, called *The Revolt against Science* (1978), in which he defended the value of science and rationality. For members of the scientific community, best-selling books such as Erich von Daniken's *Chariots of the Gods* (1969), were clear proof that such a failure of confidence in science was rampant. The popularity of such books and the renewed interest in Velikovsky's theories during the late 1960s compelled the scientific establishment to respond. It is significant that both the American journal *Science* and the British scientific weekly *Nature* carried editorials on pseudoscience in 1974. The editor of *Science* had this to say:

> The popularity of pseudoscience books at universities should be a source of concern to academic people, particularly scientists. The new trend comes at a time when many universities have abandoned requirements that students be exposed to as little as one science course. It is not pleasant to contemplate a situation in which our future leaders are being steeped in fantasy and are exposed to a put-down of science without effective response. The university community has a special obligation which it has not been meeting very well. It should move toward providing antidotes to the new intellectual poisons. In meeting these challenges to rationality, we should all remember that although humanity is eager to accept mysticism, it is also capable of yearning for truth. (Abelson, 1974, p.1233)

It is necessary to consider this context in order to understand two of the most significant disputes about the

boundaries of science in the twentieth century. These two disputes involved attacks on two of the most well-established scientific theories: the Darwinian theory of evolution in biology; and the Newtonian model of the solar system in astronomy.

In one sense, it would be possible to expect that critiques from non-scientists of such well-established paradigms could be quietly ignored. But given the general context of attacks upon science, members of the scientific community recognised a need to define publicly the boundaries of science. The fact that such established theories could be widely doubted reinforced a diagnosis of basic public ignorance about modern science.

But while the problem of communication between scientists and the lay public is relevant to these disputes, the attraction of heretical and deviant doctrines cannot be explained solely in terms of a general scientific ignorance. These twentieth-century demarcation disputes involve questions about the nature of scientific evidence, the competing claims of different disciplines, the problem of specialisation, the conflict of professional experts and the public, the nature of authority in science and the ideological aspects of scientific theories.

## 5.3 Disciplines in collision: the Velikovsky Affair

The episode which forms the object of our assessment is known as the Velikovsky Affair. It began in 1950 with the publication of a book entitled *Worlds in Collision* by Immanuel Velikovsky, a Russian psychiatrist who had lived in the United States since 1939. The basic points of the book's thesis are summarised in reading 23, but the essential point is that it was a theory which challenged established views in astronomy. Against the orthodox view that the solar system (in which Earth is a planet) has existed in a stable form for millions of years, Velikovsky claimed that there had been catastrophic events involving near collisions between Venus and Earth (1500 B.C.) and Earth and Mars (687 B.C.) in comparatively recent historical time.

Even before it was published, the manuscript of *Worlds in Collision* brought a swift and critical response from certain sections of the scientific community, beginning with an influential group of astronomers at Harvard. The book was published by Macmillan but the company soon came under pressure from the scientific educationists who threatened to boycott all its science textbooks. Macmillan capitulated and gave over the rights to what was already a best-seller to Doubleday.

This opposition to Velikovsky's theory (from powerful sections of the scientific community) has continued since 1950. The controversy was sustained by further publications

by Velikovsky - *Ages in Chaos* (1952), *Earth in Upheaval* (1955) and *Oedipus and Akhnaton* (1960). But it was also renewed by the appearance of a well-organised and vocal group of supporters who took up the author's case and pursued it in a variety of forms. For example, in 1962 the *American Behavioural Scientist* magazine devoted an entire issue to the topic, criticising the response of leading scientists as a flagrant violation of the self-professed norms and values of the scientific community. The contents of this edition were published in book form in 1966 as *The Velikovsky Affair*, edited by Alfred de Grazia.

Although some of Velikovsky's supporters have been scientists, it is significant that some of the most vocal, such as de Grazia, have been sociologists. The controversy surrounding Velikovsky's theory coincided with the appearance of Merton's sociology of science as an influential sub-discipline in North America. As we saw in reading 16, Merton described the norms which characterised the activity of the scientific community. The essential feature of his work was the image of science as a community of objective scholars open to new ideas. Sociologists who accepted Merton's work condemned the treatment of Velikovsky as a violation of the norms of the scientific community; the scientists who accepted these norms agreed. From this perspective, therefore, the Velikovsky Affair is viewed as a black mark on the reputation of the scientific community; it is seen as a lapse from the objectivity and openness which should characterise scientific activity. In this sense, it is quoted as a moral example, a warning of what happens when Merton's norms of science are ignored. This is the sense in which it still functions in the second edition of de Grazia's book (1978), where the editor implies that the scientific community should make more effort to consider Velikovsky's rival account of astronomical history.

Velikovsky's scientific critics did not consider that the norms of science had been broken. Most of them regarded this issue as irrelevant: their focus was on the character of his theory, the nature of its evidence and mode of argument. The persistent theme of the scientific attack was one which stressed Velikovsky's radical departure from established scientific views. That is, the fact that his theory constituted such a massive contradiction of the best confirmed theories in science was taken as sufficient grounds for its rejection.

If Merton's norm of 'organised scepticism' had been operating, the scientific community should have been willing to test Velikovsky's propositions and they should not have expressed such anxiety about its challenge to currently orthodox views. In fact, however, the Velikovsky Affair suggests that theoretical and methodological norms are more central to the structure of the scientific community than Merton's social norms.

One writer has made this point as follows:

> The Velikovsky case points to rigidity rather than fluidity in the intellectual commitment of the natural scientist. This rigidity becomes more intelligible when we recall the intensive educational process in science and that the intended goal of this process is primarily the attainment of a familiarity with a body of established knowledge rather than the inculcation of social norms. (Mulkay in Barnes ed., 1972, p.131)

The ideas we have drawn upon in section 4 should allow us to appreciate this view. Thus, the work of Barber, Polanyi and Kuhn reveals the conservative and, at times, dogmatic character of the scientific community in its resistance to new ideas. This suggests that the opposition to Velikovsky, although extreme for certain reasons, represents an extension of, rather than a qualitative break with, normal scientific practice. But we still need to confront the intensity of the response and to explain why Velikovsky's theories were condemned as 'pseudoscientific'.

In the demarcation disputes studied in section 3, we found it more productive to see pseudoscientific doctrines as conflicting with a particular established discipline rather than with the whole scientific community. Indeed, in the cases of mesmerism and phrenology, some sections of the scientific community were receptive to the doctrines in question. And so, in the case of Velikovsky: although most orthodox scientists initially condemned his theories, we need to be more precise about the nature of the conflict. What theories, paradigms and assumptions did Velikovsky challenge? What disciplines were involved? What kind of evidence did he employ? Which disciplines did he rely upon for his evidence and argument?

You should keep these questions in mind as you study readings 23-25. George Kolodiy's essay (reading 23) will serve as an introduction to the dispute, but it also begins to confront some of the questions posed above. For example, which paradigms were in collision? If Velikovsky had challenged less well-established theories, would the reaction to him have been so severe?

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Read George Kolodiy, 'Paradigms in collision', reading 23.

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The next two essays by Lynn Rose (readings 24 and 25) focus on the role of disciplines in the dispute. It should be said that Rose is a supporter of Velikovsky and, during the early 1970s, wrote for a journal called *Pensée*, which was established to pursue his cause. Reading 24 emphasises the interdisciplinary character of Velikovsky's work: that is, the fact that it involved evidence from a variety of disciplines, ranging from 'hard' physical sciences such as

astronomy and chemistry to 'soft' social sciences such as history and sociology, not to mention literature. Recall our discussion of the hierarchy of scientific disciplines in sections 3 and 4. If you then note that the impetus for Velikovsky's work came from the social science and humanities disciplines, the violent reaction from physical scientists can be explained. Reading 25 explicitly addresses the way in which Velikovsky challenged not only a specific scientific theory but also the hierarchy of knowledge within science. Using evidence from history, a discipline at the bottom of the hierarchy, Velikovsky challenged astronomy, the queen of the sciences. In your essay, you should try to explain this conflict between astronomy and history. Note also, that some of Velikovsky's 'historical' evidence could be regarded as 'mythology'.

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Read Lynn Rose, 'Interdisciplinary synthesis' (excerpts), reading 24 and 'The domination of astronomy over other disciplines', reading 25.

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Some of the issues related to these questions about the role of disciplinary boundaries and paradigms may be highlighted by the contrasting views in the following quotations:

(a) 'Velikovsky has managed to talk to people about mythology, archaeology, astronomy and geology, without doing injustice to those disciplines, in an amazing and unprecedented manner.' (de Grazia, 1978, p.2)

(b) It would have taken a great deal of creative effort to have put [Velikovsky's work]...in a form acceptable to specialist physical science. It spans many disciplines and appears to ask for evaluation in a manner which is not restricted to a single discipline. (Dolby, 1975, p.171)

If you take these quotations in conjunction with the readings by Rose, you will see that conflicting ideas about the significance of disciplines, interdisciplinarity, specialisation and synthesis are central to the debate about Velikovsky's theories.

While the readings by Rose provide material about the intellectual factors of the dispute, reading 26, by Norman Storer, gives an account of the sociological factors, and rehearses the views of Merton and Kuhn which we discussed in section 4.

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Read Norman Storer, 'The sociological context' (excerpts), reading 26.

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When preparing to write the essay, you should re-read section 5, especially from 5.3, considering the questions it raises, together with those posed in Tutorial Two.

## A NOTE ON UNIFORMITARIANISM

Rose also introduces the term uniformitarianism. Since we have not discussed this before, some explanation is required. This term first appeared in the 1830s and was used to describe a doctrine proposed by Charles Lyell, in his *Principles of Geology* (1830-33), which argued that all past geological phenomena (e.g. formation of mountains) must be explained by forces or causes observed in the present. The term can best be understood by noting the position which it opposed: the doctrine of *catastrophism*. This term, also coined in the 1830s, referred to geological theories which claimed that forces acting in the past were far greater and more violent than those acting in the present. It argued that massive geological phenomena such as valleys and mountains were not produced by the slow accumulation of gradual change (as Lyell suggested), but by sudden, catastrophic events.

These terms had significance beyond the discipline of geology. Catastrophism was associated with scientific theories which continued to invoke the possibility of divine intervention in the natural world: that is, God acted directly, through some catastrophic event, to produce certain effects: for example, the Ice Age or the extinction and origin of animal species. Uniformitarianism was the position of the scientists who accepted only natural, material causes in scientific explanation and rejected any appeal to supernatural forces.

Of course, as we know, the uniformitarian position became the orthodoxy of the scientific community. Charles Darwin's *Origin of Species* (1859), which proposed the concept of natural selection to account for evolution, is often seen as the final triumph of this position over theories which invoked supernatural causes, such as miracles, to explain the emergence of man. However, as we shall see in reading 27 (discussed in Tutorial Three) the recent revival of biblically based views of creation in the United States poses again the conflict between uniformitarianism and catastrophism.

In the broadest sense, these terms have come to stand for contrasting metaphysical positions. Uniformitarianism can be described as a metaphysical assumption of modern science in the sense that it is not demonstrated, tested or proved. It is not possible to prove that all past events have been brought about by causes of the same kind as those acting today, simply because it is not possible to observe such events. Nevertheless, science operates on this assumption. When astronomers claim to have established the position that planets occupied thousands of years ago, they do so by calculating backwards from the present situation, assuming the laws of gravity to have acted uniformly over that period. Thus, when Velikovsky argued that catastrophic events had occurred within recorded history, he challenged the basic working assumptions of astronomy, geology and biology.

## TUTORIAL TWO

This tutorial is intended to help you with the planning of your essay. Since the last tutorial, we have discussed some of the historical changes which occurred in the scientific community after the nineteenth century; for example, the widening gap between professional experts and the public and the increasing specialisation of science into disciplines and sub-disciplines based on paradigms. You are asked to comment on these factors when writing your essay on the Velikovsky Affair.

You will have now completed readings 23-26, which deal with this case. The essay requires you to analyse the conflict between Velikovsky and the established scientific community, showing the points of conflict and the issues involved. Readings 23-26, studied in conjunction with the discussion of section 4 (especially the work of Barber, Polanyi and Kuhn), provide the material for this. There will be an opportunity for questions about these readings in the tutorial.

The essay also asks you to compare the factors operating in this dispute with those operating in other demarcation disputes we have studied. So far, we have looked at the controversies surrounding mesmerism and phrenology in the late-eighteenth and early-nineteenth centuries. In order to give you the chance to compare the Velikovsky case with another modern controversy, reading 27 introduces the dispute between religious fundamentalists and evolutionary biologists in the United States. It is significant that the anti-evolutionists often refer to themselves as 'creationist scientists', for central to this debate is a struggle about the definition of 'science'. This has quite concrete legal implications in the United States because the religious fundamentalists have been attempting to get the biblical account of creation taught <u>as science</u> in schools and universities.

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Read Dorothy Nelkin, 'Creationist science' (excerpt), reading 27.

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This presentation of the Bible as science marks a shift in the tactics of the fundamentalist lobby. During the 1920s they had tried, with success in some states, to have evolutionary teaching banned on moral and social grounds claiming, for example, that it undermined the Christian notion of man's uniqueness and his moral responsibility. As Dorothy Nelkin shows in reading 27, the effects of this opposition lasted into the 1960s, with many biology textbooks avoiding the Darwinian theory of evolution.

Once evolutionary theory was established as part of the school curriculum, there was an attempt to allow the

creationist account 'equal time' in biology classes. In 1969, the California Board of Education issued directions to the state's public schools in support of this policy. Complex legal battles followed. Scientific groups opposed the inclusion of biblical teaching as unconstitutional, arguing that it infringed the separation of Church and State by introducing religious doctrine into public schools. This objection was upheld by the Supreme Court. Consequently, the whole thrust of the fundamentalist campaign rests on the claim that the Book of Genesis is an alternative scientific account of the origin of the earth and its inhabitants. Whereas the aim of biblical fundamentalists in the 1920s was to get evolutionary theory out of schools, they are now trying to get their own theory in, on an 'equal time' platform. And so, a supernatural account of creation in a religious document is offered as a scientific theory. This is a demarcation dispute *par excellence*!

Questions for discussion

These are intended to help you compare and contrast the factors operating in the demarcation disputes we have studied.

1. Is there any similarity in the kind of evidence used by Velikovsky and the creationist scientist?

2. Which theory (if either) do you think presents the most serious challenge to orthodox science?

3. Which is the more interdisciplinary of the two theories? Compare the disciplines with which the two theories conflict.

4. Compare the evidence used by Velikovsky and the phrenologists. Could phrenology be said to be more 'scientific', in the context of the nineteenth century, than Velikovsky's theory is today? Could the same be said of mesmerism?

5. How does the scientific response to Velikovsky compare with the response to mesmerism and phrenology? Can the concepts of professionalisation and specialisation help to explain any differences?

6. 'Phrenology and mesmerism were deviant doctrines within the scientific community; creationist science and Velikovsky's theory are pseudoscientific doctrines outside the scientific community.' Comment on this statement.

7. Return to the imaginary conversation on p.28. Why do you think Velikovsky (but not Mesmer) was excluded from the *Dictionary of Scientific Biography*?

## 6 CONCLUSION

In this course we have looked at the ways in which knowledge has been categorised and classified. By taking the example of scientific knowledge, we have investigated the formation and maintenance of boundaries between the categories of scientific and pseudoscientific knowledge. The course has emphasised the social and historical factors involved in this process of classifying knowledge.

We began by showing how the word science has shifted in meaning, gradually assuming the specialised sense of physical or natural knowledge during the nineteenth century. These changes in what has counted as scientific knowledge indicated the problematic character of the category of pseudoscience.

Using historical case studies, we discussed the weaknesses of Whig or 'progressive' accounts which employ modern criteria in classifying past theories. In the cases of astrology, mesmerism and phrenology - doctrines now condemned as pseudoscientific - the historical evidence suggests a complex situation: these doctrines had definite affinities with orthodox scientific theories and were not universally rejected by members of the scientific community.

This suggested that a distinction between science and pseudoscience based on twentieth-century conceptions of orthodox science could not be properly applied to earlier historical periods. Our case studies also suggested that these demarcation disputes could not be represented as simple clashes between science and pseudoscience. Instead, they often involved conflicts between a new theory and the paradigms of an established discipline. This led us to a discussion of the character and role of disciplinary boundaries within the orthodox scientific community, and allowed us to see the pseudoscience issue as an extreme case of the way in which scientific disciplines behave. By noting historical changes in the scientific community, such as specialisation and professionalisation, we raised questions about the different conditions under which the demarcation between science and pseudoscience has been made.

The courses in Phase 1 of this programme have used ideas, concepts and empirical data from a range of disciplines within the humanities and social sciences. In so far as we are raising questions about the classification of knowledge, this final course may provide a bridge to the Phase 2 courses which are explicitly concerned with areas of inquiry defined by different disciplines.

Firstly, one emphasis of this course is that the classification of knowledge into disciplines has a historical dimension. It might therefore lead you to ask how and when subjects such as history, literature and sociology assumed their present forms. Secondly, while focussing on natural science we have raised questions about

the category social science. For example, in discussing the concept of a hierarchy of knowledge, we noted the way in which so-called 'hard' sciences were defined as superior to 'soft' sciences; and we saw that this issue often entered into debates about pseudoscience. Thirdly, by treating the ways in which scientific disciplines are constituted by certain paradigms - assumptions, theories, methods and forms of evidence - this course should suggest questions which can be asked when studying and using other disciplines.

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## FURTHER READING

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## ANSWERS TO SELF-ASSESSMENT QUESTIONS

SAQ 1 (p.11)

The first point to make about this question is that there can be no fixed and certain answer. The point of the discussion so far has been to show that the meaning of the term 'science' underwent various changes. Before the nineteenth century, it was common to refer to subjects such as theology, logic, geometry and mathematics as 'sciences' because they dealt, systematically, with abstract knowledge of great certainty. On the other hand, the term 'science' was often not applied to geology, chemistry and botany because, although they dealt with empirical observations of nature, the knowledge they gave did not have the certainty of the first group of subjects. Astronomy, however, because it was able to offer laws of nature expressed in mathematical form, was the first subject of 'natural philosophy' to be seen as a 'science', in the sense of certain knowledge derived deductively from first principles or axioms.

SAQ 2 (p.12)

The crucial shifts listed by Williams include:

1. the distinction between art and science which became established by about the seventeenth century (R3:1). (The last quotation, suggesting a synonymous usage cited by Williams, is one of 1422.)

2. the shift from 'science' referring to knowledge in general to systematic, theoretical knowledge. Thus the 1725 definition of 'science' as a 'body of regular or methodical observations or propositions...concerning any subject of speculation' (R3:1). This could therefore include subjects, such as theology or philosophy, which are not considered sciences today.

3. the specialisation of the term from systematic, theoretical knowledge to experimental, empirical knowledge of nature. This was the major shift and Williams sees it as related to the distinction between experience and experiment (R3:1). Although both these terms referred to observation and could result in empirical evidence, experimental observation was seen to be more controlled, technical and theoretical. This came to be taken as the chief criterion of the natural or physical sciences.

4. the distinction between these natural sciences and other forms of systematic knowledge (e.g. theology, philosophy, logic) which previously counted as sciences. Thus, from the nineteenth century, the dominant meaning of science was natural knowledge based on observational

> and experimental inquiry into the physical world. This meant that, for example, philosophy and psychology, which dealt with mental rather than physical events, were not classified as sciences. However, the new social sciences, such as anthropology and sociology, attempted to claim the status of sciences because they used scientific methods of inquiry (R3:2).

SAQ 3 (p.18)

Thorndike claims that the quest for universal laws of nature, which is often said to date from the work of Galileo, Kepler and Newton (i.e., late-sixteenth to mid-seventeenth centuries), actually has a longer history. He argues that the assumption about the universality of natural law was central to astrology. Thus, before Newton's theory of gravitation was proposed as a universal law explaining a large range of phenomena, astrologists had proposed general laws which linked events on earth to those of other celestial bodies.

Thorndike is arguing against a Whiggish view which would see all aspects of the scientific attitude beginning with Newton, and condemning earlier astrological doctrines as mere superstition. When Newton accepted the assumption that there were 'universal laws which governed particular events, and that nature as a whole was subject to immutable laws' (Thorndike, R4:2), he was accepting an idea basic to astrology. Thorndike is therefore trying to soften the hard line which Whiggish historians draw between astronomical science and astrology, by underlining the general assumptions they shared.

SAQ 4 (p.20)

Thomas points out that one of the key notions in astrology was the belief in the immutable nature of the heavens. Various astronomical discoveries, however, such as 'new stars' and the moons of Jupiter, suggested that man did not have full knowledge of the heavens. If the heavens contained other unseen stars, how could their influence on earth be predicted?

The new astronomy also undermined the distinction between terrestrial and celestial bodies which had been central to astrology. If the earth was a planet subject to the same laws of motion as other planets, the idea of a one way influence from the supposedly perfect celestial spheres to earth was no longer tenable.

As Thomas notes, these intellectual tensions did not mean that astrology immediately collapsed: some important astronomers continued to accept some astrological beliefs. But by the end of the seventeenth century the attempt to

reconcile it with the new astronomy was abandoned; its conception of coincidence between time of birth and position of stars was no longer accepted as a causal relationship in education circles.

SAQ 5 (p.22)

Sprat attempts to show that the concerns of the Royal Society do not touch on any controversial subject or on any topic where diverse opinions are likely to exist. The obvious topic to be excluded is therefore religion and Sprat contrasts the various religious sects (e.g. Popist versus Protestant) and their disputes with the unity of the Royal Society in its pursuit of natural knowledge.

SAQ 6 (p.25)

In Popper's view, the main tenets of these doctrines can't be properly tested. For him, this means that they don't give rise to statements or hypotheses which can conceivably conflict with possible observations or experiments. If a theory cannot be conceivably falsified in this way it is not testable, and therefore not scientific. Thus, although Marxism, as a theory of history, can give rise to predictions about the arrival of the socialist revolution, its proponents, according to Popper, always invoke other factors to explain away the failure of the revolution. This means that Marxism cannot be falsified by any result; it is therefore not susceptible to proper scientific testing. Thus it is not a science. The same applies, even more so, in Popper's view, to psychoanalysis and astrology.

SAQ 7 (p.28)

Darnton suggests that mesmerism had various links with the more respectable sciences of the period; that is, he does not see it as a clear pseudoscience compared with the contemporary orthodox sciences.

He urges the need for historical sensitivity, reminding us that medical theories of the period tried to model themselves on the successful physical sciences, giving rise to 'speculations that read like science fiction today but passed as respectable varieties of Newtonianism in the eighteenth century' (R10:1). Thus, the idea of an invisible fluid, which Mesmer proposed, was also an idea in the more orthodox theories concerning gravity, magnetism and light.

SAQ 8 (p.29)

1. Weyant, like Darnton, points to similarities between the general assumptions of Mesmer's theory and the reputable sciences of the period. Mesmer specifically rejected

magical ideas and argued for material influences in the form of invisible fluids, a concept also found in orthodox sciences.

2. The physical scientists did not deny the effects of mesmeric practice, only its purported cause. After subjecting mesmerism to experimental tests, they concluded that there was no evidence for the action or existence of animal magnetism. Moreover, they were prepared to suggest that the effects of mesmerism (e.g. trances) were produced by imagination. Weyant suggests that imagination was seen as a psychic rather than a physical phenomenon, and therefore fell outside the mechanical and materialist tradition of physical science.

   In this sense, the suggestion that mesmerism may have involved the action of imagination was consistent with the Commission's conclusion that it did not involve any scientifically assessable cause.

SAQ 9 (p.31)

1. Orthodox medicine could not afford to ignore mesmerism, because its own professional status was insecure. Firstly, medical theory about illness and disease did not rest on strong scientific foundation. This is one reason why medical doctrines such as mesmerism could flourish. Secondly, the social standing of general medical practitioners was not high: they were regarded as a marginal group. Also, before legal reform in the area of health care, they did not enjoy any monopoly and had to compete with other forms of treatment offered by groups such as the mesmerists. As Parssinen notes (R12:5), there was a popular belief in 'the right of every Englishman to select his own brand of medical treatment'!

   Medical reformers tried to improve the reputation of the profession by emphasising formal educational qualifications, by promoting a serious moral image and by condemning other groups as disreputable quacks. Thus, by attacking mesmerism as a deviant doctrine, orthodox medicine was able to strengthen its professional boundaries.

2. James Braid coined the term 'hypnotism' in 1883, and he saw it as part of mesmeric phenomena. However, he argued that it was produced by purely psychological effects on the imagination of the patient not by a fluid of magnetism. At first his theory was rejected because the medical profession regarded his views as very similar to mesmerism, even though mesmerists did not accept Braid's explanation.

   However, by the end of the century when the medical profession was more secure, both in its theories and in

its legal and institutional position, Braid's hypnotism was accepted as a form of therapy in certain areas of treatment. Thus, according to Parssinen, it was not so much that hypnotism was theoretically distinct from mesmerism, but rather that the professional status of medicine was more secure by the end of the nineteenth century and that this allowed it to tolerate hypnotism.

SAQ 10 (p.35)

Parssinen mentions the charge of fatalism made by Sir William Hamilton: this was that phrenology denied free will. Related to this was the charge that phrenology was a materialist theory of the mind which conflicted with the Christian notion of a spiritual soul. Mental philosophers saw the mind as an indivisible entity and thus rejected the phrenological concept of a plurality of mental organs located in the brain.

P.M. Roget - a scientist and also the author of *Roget's Thesaurus* - summarised anatomical objections; for example, many parts of the brain had been destroyed without apparent change in intellectual and moral behaviour; also, there was no close fit between the exterior shape of the skull and the underlying brain and so phrenological analyses had no basis.

You should notice that not all of these objections were scientific: there were religious and philosophical criticisms which, at a time when the scientific community was not divorced from the dominant social values, could be just as damaging as scientific attacks. By the 1840s, the scientific evidence, from anatomy and cerebral physiology, was going against phrenology. But, as Parssinen notes, the collection of this evidence led researchers to inquire into phrenological concepts, such as the localisation of different faculties in different areas of the brain. In this sense, although its detailed tenets were incorrect, phrenology led scientific research into productive directions. This suggests that the relationship between pseudoscience and science should not be seen as one of simple antagonism.

SAQ 11 (p.39)

Phrenology appeared to offer some guidance to the most insecure areas of medical knowledge. For example, in rejecting traditional mental philosophy and commencing with the assumption that the mind was the organ of the brain, it encouraged neurological research. It must also be recognised that medicine lacked a secure scientific foundation at this time, and phrenology offered a materialist theory for difficult areas, such as insanity.

SAQ 12 (p.44)

1. Initially, it was certain theological groups, such as the High Church Anglicans who resented the way in which the natural scientists of the British Association were trying to define science to exclude theology and philosophy - subjects which they considered sciences. If you return to section 2.1 you will see that the cultural critic, John Ruskin, also made this kind of complaint. The existence of such responses reminds us of the profound historical shift entailed by the specialisation of 'science' to include only natural science.

   You could also note that metaphysics (or philosophy) made some claim to the status of science. However, subjects which did not deal with empirical evidence could be more easily excluded from the BAAS than phrenology, education and social statistics. The last three subjects claimed to be social sciences.

2. Phrenology threatened the idea of science which the leaders of the BAAS were trying to construct; and it was this threat, apart from any substantial criticisms of its theory, which motivated its opponents.

   There were various aspects of this clash between phrenology and the image which the BAAS promoted. For example, its materialist doctrines involved phrenology in theological arguments which the BAAS desperately wished to avoid: to allow such controversies within the Association would suggest a lack of harmony between science and religion.

   Perhaps most significantly, however, was the fact that the phrenologists claimed that their subject, as a human science, was more important than physical disciplines such as geology, and that it should be included.

3. The attempt to confine social statistics to collections of facts was an attempt to keep political value judgements out of the BAAS. This was a difficult task since social statistics at this time primarily dealt with subjects in political economy such as poverty, factory conditions and the effects of various economic policies. Having established a statistical section, the leaders of the BAAS tried to limit its activities to the collection of empirical facts, and discouraged generalisations which might point to causes of a political nature.

   Thus, although phrenology and social statistics were quite different subjects, they raised a common problem because they threatened to bring questions of a religious, moral and political kind into the BAAS - an association which wanted to present science as politically neutral and value free.

SAQ 13 (p.47)

1. Each of Merton's four norms is seen as encouraging an 'open' scientific community and an 'objective' attitude to knowledge. Thus, universalism refers to the existence of impersonal criteria for assessing theories - criteria which are above class, race and personal differences.

   Communism is supposed to ensure the free circulation of ideas within the scientific community. Thus, although there is competition between scientists for recognition, results, once achieved, should be published and communicated. The norm of disinterestedness is supposed to make the search for knowledge the primary motive of science, one that is not influenced by factors such as personal beliefs or political considerations. The final norm, organised scepticism, epitomises the open character of science: it refers to the critical yet unbiased assessment of all questions, problems and theories.

2. Merton suggests that pseudosciences thrive and influence the non-scientific public when the authority of scientific experts is not adequately exercised (R16:2). Laymen cannot distinguish between sound science, on the one hand, and, on the other, doctrines such as racism which have claimed scientific status.

SAQ 14 (p.48)

1. Barber refers to the tradition established by nineteenth-century scientists, such as Huxley, which views religion and theology as obstacles to scientific progress. However, Barber points to the fact that members of the scientific community have themselves held religious ideas and have been influenced by them in their scientific work. Thus, many nineteenth-century scientists opposed an early evolutionary theory (proposed by Chambers) on religious as well as scientific grounds. Barber does not say that this was a 'bad thing'; his point is that the scientific community is not divorced from other social values. That is, Merton's norms, such as 'organised scepticism', do not always operate in science. Scientists, like non-scientists, have other beliefs and values which influence their work. For Barber, Merton's view of science is an abstraction not borne out by historical evidence.

2. Barber argues that scientific theories are often judged, at least initially, in terms of the professional status of the person proposing them, rather than in terms of their intrinsic merit. The case of Mendel's work is often cited.

Specialisation can also lead to resistance by expert scientists to theories advanced by people outside their speciality. Pasteur was rejected by medical men because he had chemical, not medical, training. Such 'outsiders' often lack the vocabulary and the training of the special area which their theory touches on; they therefore find it difficult to put their theory in terms which will be recognised by the relevant experts. Theorists who propose general, synthetic theories embracing several specialised disciplines are bound to meet resistance. We will see a case of this in the Velikovsky Affair.

SAQ 15 (p.49)

1. Polanyi recognises that with the growth of a scientific community in Europe during the seventeenth century, the defenders of science had to struggle against the authority of the Church. The religious authorities, through their connections with political power, were the dominant intellectual authority. The scientific community, on the other hand, was a loose group of men whose theories often conflicted with traditional religious and philosophical ideas.

   Thus, until the late-nineteenth century, it was accurate to regard science as opposing authority. But with the decline of religious belief and the increasing organisation and institutionalisation of science, the scientific community itself became a source of authority. In fact, as Polanyi and Barber argue, scientific ideas not sanctioned by the authority of leading experts have little chance of recognition.

2. Polanyi sees scientific authority as traditional in the sense that it seeks to conserve or maintain knowledge and theories which have been sanctioned by the relevant experts in the scientific community. When a scientist joins the community, he accepts, without reassessing for himself, a large number of ideas and values; these are transmitted by tradition over generations, just as legal traditions are transmitted.

SAQ 16 (p.51)

1. Kuhn emphasises the role of textbooks in science education. These introduce the student to the orthodox views current in the particular area of science, its crucial experiments and accepted theories. They train students to work through examples of previously successful experiments; and they do not encourage students to go outside a clearly-defined range of problems. In the humanities, according to Kuhn, there is less agreement about the fundamentals of a particular discipline, and textbooks in this area often expose the student to a variety of conflicting theories.

2. Kuhn sees scientific education as dogmatic in the sense that it enforces a particular set of questions or problems defined by a paradigm. A paradigm could be defined by a major piece of work, a classic text, such as Newton's *Principia* (which outlined his theory of gravitation).

   Science education is dogmatic in the sense that it inculcates certain paradigms - those currently prevailing in each area of science - and does not encourage questions outside the range of the paradigm. Theories which conflict with the paradigm meet resistance and the evidence they offer is often dismissed or reinterpreted so as to be explicable within the dominant paradigm.

SAQ 17 (p.59)

1. Kuhn claims that in the 'pre-paradigm' stage of a scientific discipline there is no clearly dominant theory or interpretation of facts. Instead, there may be several theories or approaches available. In its extreme form, according to Kuhn, this pre-paradigm stage may be simply a fact-gathering exercise and, due to the absence of a paradigm, this could be random fact-gathering because there is no way of deciding that some facts are more relevant than others. He acknowledges, however, that truly random or non-directed fact collecting is rare: the criteria for selecting facts about nature may be supplied by a religious or metaphysical doctrine. The main point is that in the absence of a single strong paradigm, there is no clear set of problems which impel research in a definite direction.

2. Before one paradigm becomes established, Kuhn suggests that the book is the major form of publication; once a paradigm is established, the journal article or research paper is the most common form.

   In the pre-paradigm stage, there are competing efforts to establish the fundamental principles and research problems of a science. Historically, these attempts to define a basic approach or to outline a major theory have occurred in books, such as Newton's *Principia* or Darwin's *Origin of Species*. In turn, these have been taken as classic texts, expressing the paradigm of a discipline and determining the research agenda.

   However, research within an established paradigm is normally published in articles and papers of more limited circulation. Different sciences have reached this stage in different periods: for physics, the transition from books to articles came in the eighteenth century; for geology and biology it came in the nineteenth century.

Kuhn notes that one of the consequences of this transition from book to article is the hardening of the line between professional experts and lay amateurs. The disappearance of the book as a form of communication is usually a signal that the discipline has become too specialised to allow any participation by non-professionals. If amateurs do try to participate in such disciplines they are ignored or dismissed as 'quacks'. Conversely, as Kuhn suggests, a professional who publishes a book in his area is likely to risk his reputation by opening himself to the charge of popularisation.

SAQ 18 (p.61)

1. Meadows compares the cases of mathematical and experimental disciplines (e.g. physics, physiology) with that of observational, environmental disciplines (e.g. zoology, geology). The point here is that the development of professionalisation occurred at different rates in different fields of science. In the late-nineteenth century, amateur involvement in zoology was still relatively high compared to the situation in chemistry, which had become restricted to full-time professionals. Experimental and laboratory based sciences required special skills and training not easily acquired by the part-time amateurs; in disciplines such as zoology, however, there was still room for observations made by the part-time participant in science.

2. Meadows points out that when the Geological Society of London was founded in 1807 its publications were expected to be available to the general reading public. Gradually, geological publications shifted from books to journals. We noticed Kuhn's comments on this transition in SAQ 17(2). Meadows, however, adds a further dimension. He indicates that even when most geological research was published in journals, a large part of it was general in character and accessible to amateurs. It was not until the early-twentieth century that specific journals began to specialise in various sub-branches of geology (e.g. geochemistry, geophysics) and that the general journal became extinct.

## GLOSSARY

The brief definitions given below of terms which are italicised and marked with an asterisk in this study guide are in no way exhaustive.

It is suggested that you also consult a dictionary in the case of new or uncertain terms, whether or not the definition is included here.

alchemy: medieval doctrine about powers of natural substances which claimed that base metals could be transmuted into gold; often seen as forerunner of modern chemistry.

diachronic: chronological or historical change.

empirical: knowledge based on experience, such as observation or experiment, rather than theory.

epistemology: the theory or study of how we come to have knowledge of the world. Typical conflicts in this field centre on the relative importance of observation, intuition and reason in acquiring knowledge.

materialism: the claim that all phenomena can be reduced to explanation in terms of physical events or causes.

mesmerism: Eighteenth-century theory which claimed that an invisible animal magnetism could affect human behaviour, often therapeutically. In so far as it produced trance-like states, it is regarded as a precursor of hypnotism.

naturalism: a term, often used synonymously with materialism.

natural sciences: the physical sciences (such as physics, chemistry, geology) as distinct from the social sciences.

paradigms: models or exemplars which guide research in science.

phrenology: doctrine claiming that human character could be assessed by studying 'bumps' on the head which reflected underlying shape of the brain.

physiognomy: doctrine claiming that human character could be read by studying facial expressions.

rationalism: the belief in the ability of reason, logic and science to comprehend the world without recourse to intuition, tradition, religion or mythology.

sub judice: term used to describe matters and cases currently under legal judgement and therefore not to be publicly discussed.

synchronic: events or ideas existing in the same time period; synchronic comparisons are thus made between contemporaneous phenomena.

taxonomy: a system of classification, for example, of animal species. See Course HP08a, *Classifications*.

teleology: philosophical doctrine which claims that events (e.g. historical, biological) can be explained in terms of the purpose or design of which they are a part.